SECOND ANNUAL REPORT SAN FRANCISCO OAKLAND BAY BRIDGE

Note—

¶ This is Volume II of a three-volume report, and does not duplicate the material in Volume I such as Preface, Legislation, Financing, Preliminary Design, Federal and State Authorities, and Personnel, General Description, Design Data, Contracts Let Prior to July 1, 1934, nor any of the drawings and illustrations contained in Volume I.

¶ This was done, not only as an economy, but also with a view of publishing all the reports as one at the time of the completion of the bridge.

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SECOND ANNUAL PROGRESS REPORT SAN FRANCISCO OAKLAND BAY BRIDGE

JULY 1, 1935

This copy of the Second Annual Report of the progress of construction as of July 1, 1935, of the San Francisco-Oakland Bay Bridge, which has been published to provide the authorities having interest therein with a complete record thereof, is issued to

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CONTENTS

GOVERNOR FRANK F. MERRIAM
Chairman California Toll Bridge Authority

THE SAN FRANCISCO-OAKLAND BAY BRIDGE

Designed and Constructed by the **DEPARTMENT OF PUBLIC WORKS** *of the* **STATE OF CALIFORNIA** *for the* **CALIFORNIA TOLL BRIDGE AUTHORITY**

CALIFORNIA TOLL BRIDGE AUTHORITY: Frank F. Merriam, *Governor;* George J. Hatfield, *Lieutenant Governor;* Earl Lee Kelly, *Director, Department of Public Works;* Arlin E. Stockburger, *Director, Department of Finance;* Harry A. Hopkins, *Chairman, Highway Commission.*

SAN FRANCISCO-OAKLAND BAY BRIDGE DIVISION *of the* **DEPARTMENT OF PUBLIC WORKS:** Earl Lee Kelly, *Director;* C. H. Purcell, *Chief Engineer;* Chas. E. Andrew, *Bridge Engineer;* Glenn B. Woodruff, *Engineer of Design.*

FINANCIAL ADVISORY COMMITTEE: Harrison S. Robinson, *President;* Leland W. Cutler, *Vice President;* George T. Cameron, *Chairman, Executive Committee;* C. H. Purcell, *Secretary;* W. G. Swanson, *Assistant Secretary;* Joseph Carlston,* Charles O. Conrad, W. W. Crocker, E. B. DeGolia, R. M. Fitzgerald,* Herbert Fleishhacker, A. P. Giannini, R. H. Glassley, E. Clarence Holmes, Joseph R. Knowland, Frank C. MacDonald, P. H. McCarthy,* J. H. Quinn, John P. Symes, George Tourney.*

*Deceased

BOARD OF CONSULTING ENGINEERS: Ralph Modjeski, *Chairman;* Moran and Proctor, Leon S. Moisseiff, Charles Derleth, Jr., H. J. Brunnier.

BOARD OF CONSULTING ARCHITECTS: Arthur Brown, Jr., John J. Donovan, Timothy L. Pflueger.

CONSULTING GEOLOGIST: A. C. Lawson.

ATTORNEYS: Heller, Ehrman, White & McAuliffe.

Expansion Tower on Yerba Buena Island

Preface

With the end of the second year of the construction of the San Francisco-Oakland Bay Bridge, we find that all California and indeed the civilized world is eagerly watching the progress of the construction of this vast enterprise. Wherever printing presses are turning, the people are being apprised of this California project which is spanning the four and one-half miles of San Francisco Bay.

Too great is this bridge to be the property of any part of our great State. It is the span that ties the peninsula of San Francisco to the mainland of the United States. The influence of this transportation improvement on the regions of the West which the bridge will serve is too far-reaching to be localized to any district.

Rapid transportation has been termed the modern lamp of Aladdin that transforms deserts into cities. What growth will come to the great cities around the San Francisco-Oakland Bay Bridge and to the State of California as a whole out of the building of this long-needed bridge will soon be known. It is a new glory for California.

Frank F. Merriam

FRANK F. MERRIAM
Governor

To His Excellency, **FRANK F. MERRIAM,** *Governor of California, and Members of the California Toll Bridge Authority*

GENTLEMEN:

There is transmitted herewith the Second Annual Progress Report of Chief Engineer C. H. Purcell on the construction of the San Francisco-Oakland Bay Bridge.

This Second Annual Report covers the period between July 1, 1934, and June 30, 1935, the second year of the construction period of this tremendous project.

This book will be Volume II. One additional volume is contemplated which will carry the bridge through to completion in the latter part of 1936, and which will cover a period of somewhat more than one year.

The State Department of Public Works takes pleasure in transmitting this report of the year's work under the direction of this department.

Respectfully submitted

Earl Lee Kelly

EARL LEE KELLY
Director of Public Works

Honorable **EARL LEE KELLY**
Director of Public Works
of the State of California

SIR:

Submitted herewith is the Second Annual Progress Report of the construction of the San Francisco-Oakland Bay Bridge covering the period between July 1, 1934, and June 30, 1935.

In this report will be found the record of progress of the contracts under way during the year and summaries of the new contracts awarded.

In this annual report we have not duplicated the general information on the bridge, its history, legislation, financing, preliminary and final designs, and the Federal and State personnel, all of which is published in Volume I of this series, known as the First Annual Progress Report.

Respectfully submitted

C. H. PURCELL
Chief Engineer

Aerial View of Bridge Construction on June 30, 1935

Annual Progress Report No. II

West Bay Substructure

⟦Contract No. 2⟧

Progress July 1, 1934, to June 30, 1935

The annual report for the previous year included a brief description of the construction work required by this contract, summarized progress of the work completed up to June 30, 1934, and noted features encountered on the project.

Work on the West Bay Substructure was completed on June 13, 1935, the 758th day after the execution of the contract. This section of the report summarizes all operations under the contract as well as noting progress during the fiscal year, from July 1, 1934, to June 30, 1935. 758-day Contract

At the beginning of the fiscal year, Pier W-2 for the westerly suspension bridge tower had been completed and the tower erection had been practically completed under another contract. Piers W-3, W-5 and W-6 for the other three towers were complete, except for finishing the pedestals and fenders; all difficult subaqueous work on these three piers had been finished and pier shafts had reached their tops at Elevation +40. Most of the difficult underwater work at Pier W-4, the central anchorage, was done, as the central 45 per cent had been successfully sealed to the rock at Elevation − 220 and the rock areas under the ends of the caisson were being cleaned in preparation for the last underwater work of the caissons. Construction of the huge anchorage block to Elevation +235 would follow. Based on total cost, the contract work for the West Bay Substructure was 88 per cent complete.

No unusual construction problems or features were involved in the completion of Piers W-3, W-5 and W-6. Pedestals were ground level with a tolerance of 1/16th inch, as at Pier W-2. Heavy concrete-and-timber fenders were constructed around the pier bases to protect against damage from collision. Pier W-3 construction was suspended from July 11 to October 8 to permit the superstructure contractor to erect the steel tower; then construction of the fender was completed. Dates of completion and acceptance of these piers were as follows: Tolerance 1/16 inch

Pier W-3	January 18, 1935
Pier W-5	September 20, 1934
Pier W-6	July 24, 1934

Completion of the end seals at Pier W-4 was delayed as loosened materials along the sides and ends of the caisson sloughed down underneath the cutting edge temporarily preventing satisfactory cleanup of the bedrock foundation at Elevation —220. A satisfactory seal was effected by pipes jetted down just outside the caisson and about 5 to 20 feet apart until they were a few feet above the cutting edge at the weak spots. Grout was then pumped through these pipes under great pressure into seams and fissures of the broken shale. Setting of this grout successfully consolidated the loose materials at the cutting edge. This operation required four weeks from July 6 to August 3. Cleaning of the foundation rock then proceeded satisfactorily and sealing was completed on August 22. Grouting at —210

Two Cells in Center Anchorage

Construction of the central anchorage block on this foundation was started at once. The caisson wells were capped with a slab at Elevation +25; above which the block was approximately 86 × 192 feet extending to the lower roadway slab at Elevation +234. The block was hollow with two rooms each 57 × 82 feet extending from Elevation +25 to +229, separated by a three-foot partition wall and partially interrupted by diaphragm beams and slabs at Elevations +82 and +154. Including a concrete fender similar to those at the other caisson piers, 57,000 cubic yards of concrete were required above the Mean Lower Low Water line for the central anchorage.

Construction progressed rapidly, reaching Elevation +207 by the end of December and the top on February 4, 1935; but necessarily omitting concrete from wells in the walls in which the superstructure contractor was to erect and pre-stress hold-down eyebars for the cable anchorage A-frame and stiffening truss end rockers. Erection of this steel and filling of wells with concrete were completed in alternate operations of the two contractors by May 17.

Reconstruction of Harbor Pier 24 was necessary to place Pier W-2 outside the lines of ship berths and remove hazards of fire in the vicinity of Pier W-2. Timber portion of the shed was limited by a fire wall 100 feet from the pier. The wall and a concrete deck reaching out to Pier W-2 were constructed on reinforced concrete piles. The north side of the dock and pier shed were reconstructed to conform to a berth line clearing the north end of Pier W-2. This work was started in July, and, partly due to the shortage of carpenters, was used as a fill-in job. Except for minor details, it was completed in February; all work was done and accepted on May 29.

Pier Costs

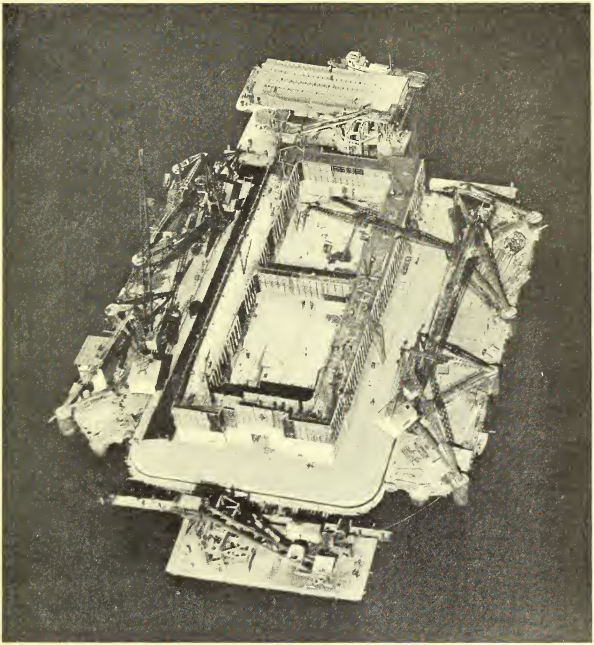
This completed actual construction under the contract for the West Bay Substructure and acceptance by the Director of Public Works was dated June 13, 1935, the 758th contract day. Final payment to the contractor shows total cost for each unit of the work as follows:

Unit	*Contract Cost*
Pier W-2	$255,580 80
Pier W-3	1,667,768 36
Pier W-4	3,391,245 43
Pier W-5	702,451 30
Pier W-6	1,259,479 50
Harbor Pier 24	193,769 58
Office	4,464 17
Total contract cost	$7,474,759 14

Compared to the original Engineer's estimate of $9,443,620.00, which included 5 per cent for contingencies, this represents a saving of nearly two million dollars.

Completion of Piers W-2, W-5 and W-6 was ahead of schedule. Essentially Pier W-3 was ahead of schedule, the contractor having ample time to complete his work when the superstructure contractor was permitted to start tower erection four months in advance of the specified date for completion of the pier. Pier W-4 construction was delayed 15 days by the welders' strike in August-September, 1933, seven days by the general strike in July, 1934, and 88 days by the additional 30 feet of penetration required to reach satisfactory foundation rock—a total of 110 days. As the contractor released the completed pier 71 days after the specified date, his performance was 39 days ahead of a properly revised schedule.

39 Days Ahead of Revised Schedule



Concrete Center Anchorage at Elevation +53 Showing Interior of Cells

Accidents and fatalities were low, considering the hazardous nature of most of the work. Five men were killed or died as the result of injuries sustained on the work. There were 230 other accidents resulting in lost time, 322 additional that required surgical attendance, and 127 minor accidents that were treated by first aid only, making a total of 684 accidents. Hence, one serious accident occurred for every 386 man-days worked; one fatality occurred for each $1,500,000 of contract cost; these frequencies are very low for this type of construction and evidence a high regard for safety of men on the part of the contractor.

Accident Rate Low

Over $1,300,000 was spent on pay rolls at the site; most of the balance of the contract cost represents pay rolls for materials secured or fabricated in the Bay

Aeriel View of West Bay Crossing, June 30, 1935

region. Although the greater part of the steel was rolled in the east, fabrication was local; the only other large item not locally procured was the timber purchased from northern mills. Over 1500 men were employed at the site; probably 2000 more were engaged in local shops and yards.

San Francisco Cable Anchorage and Shore Piers

[[Contract No. 3]]

Progress July 1, 1934, to June 30, 1935

Contract No. 3 provides for the construction of the San Francisco Cable Anchorage, the viaduct structure between the Anchorage and Rincon Hill, Piers "A" and "B," and Pier W-1. The contract for this construction, with the Healy-Tibbitts Construction Company of San Francisco, was approved on May 19, 1934. A résumé of the operations during the past fiscal year follows:

Cable Anchorage

The Cable Anchorage, a concrete structure, 184.5 feet long by 108 feet wide and rising, when completed, 148 feet above the neighboring streets, will contain approximately 68,000 cubic yards of concrete and 1200 tons of steel. Its primary functions are to anchor the westerly end of the Suspension Bridge cables and support the westerly end of the double-decked truss spans. At the Anchorage terminate the reinforced concrete viaduct spans that form the San Francisco approach to the Bridge. 68,000 Cubic Yards Concrete

The first section of the structure was completed during the last fiscal year. Since that time, with the exception of a small section constructed at the westerly face to facilitate the cable spinning, work has been discontinued pending the completion of the suspension cables. The work is scheduled to be resumed in October, 1935, and to be completed in 1936.

Viaduct

The viaduct section is a series of five 65-foot, double-decked, reinforced concrete spans, varying in height from 30 feet at the westerly, or Rincon Hill end, to 90 feet at the easterly, or anchorage end. This construction marks the westerly end of the lower deck roadway and railway bridge structure. It continues the bridge structure for the upper deck between the Anchorage and Rincon Hill, and connects at the latter point with the approach viaducts being constructed under Contracts Nos. 15–15-A. Five 65-foot Spans

Work on the foundation excavations, started during the last fiscal year, was completed by November 1, 1934, all footings being founded on rock.

The erection of timber falsework proceeded in connection with the foundation excavations, considerable delay being experienced during last December and January because of the heavy rains and resulting mud slides. To date the falsework for the lower deck has been completed, columns are concreted to the elevations of the lower deck girders, and forms for beams and girders are being built. This section, with the exception of the railings, is scheduled for completion by January 1, 1936.

Piers "A" and "B"

Piers "A" and "B," located on the westerly and easterly sides of Main Street, with their steel columns to be erected under Contract No. 6, will form the central supports for the double-decked steel spans between the Anchorage and Pier W-1.

Two Shaft Piers

These piers are similar in design, of reinforced concrete and both were constructed within open cofferdams, built of interlocking steel sheet piling, braced with suitable timbers. The piers proper are monolithic, of cellular construction between solid end shafts, only the shafts rising above street grade. The spread footings under each pier, 104 feet by 28 feet in plan and five feet thick, are founded upon a very compact sand stratum at Elevation −15. With the exception of the fact that the excavations were remarkably dry considering the proximity of the tidal water, no unusual construction details developed during the operations on this section of the contract. Pier "B" was started April 30, 1934, and completed December 12, 1934, and Pier "A" construction occupied the period between September 5, 1934, and March 11, 1935.

Pier W-1

Concrete to El. +143

Pier W-1, located directly north of Bryant Street, between Spear Street and The Embarcadero, is a reinforced concrete shaft rising when completed, approximately 176 feet above the street surface. It is supported on a mass concrete foundation which rests upon rock at depths varying from 30 feet to 70 feet below street grade. This pier marks the westerly terminus of the Suspension Bridge spans, supports the easterly end of the truss spans from the Anchorage, and carries the Cable Bent, over which the Suspension Bridge cables pass to the Anchorage. Concrete work on Pier W-1 had been completed to Elevation +28, 16 feet above street grade, at the end of the last fiscal year. Above Elevation +28 the concreting operations were continued to Elevation +143, in lifts of approximately eight feet. Elevation +143 was reached on October 24, 1934, and at that time concreting was discontinued pending the erection of structural steel. The steel cable bents and wind anchorages were furnished and erected under Contract No. 6.

Work under Contract No. 3 was resumed on January 23, 1935, and by March 23, 1935, all concreting under this contract had been completed to Elevation 169.5. There will be no further operations on this section of the contract until the completion of the roadway slab on the truss spans. At that time the pylons at the northerly and southerly ends of Pier W-1 will be completed to the final elevation.

Equipment

There are no unusual pieces of equipment in use on this contract. The concrete plant described in the first report furnishes concrete for all parts of the contract, trucks being used to transport the material from the plant to the various units. At Pier W-1 a two-yard bucket and tower raised the concrete to the elevation at which it was being deposited and the same bucket and a similar tower is in use on the Viaduct. Rubber tired concrete buggies are being used to transport concrete from the towers to the point of deposit. All concrete is being compacted by the use of internal vibrators.

Summary of Work Completed to Date

Excavation	47,178 c. y.
Structural Steel Placed	2,091,650 lbs.
Reinforcing Steel Placed	1,094,577 lbs.
Concrete Poured	58,028 c. y.
Miscellaneous Work	19% completed
Percentage of Project Completed	70%

Expenditures

Amount Earned by Contractor	$767,646 08	
Amount Retained	76,924 61	
Amount Paid to Contractor		$690,721 47
Incidental Expenditures		43,311 34
Total Expenditures to Date		$734,032 81
*Estimated amount necessary for completion		$524,000 00

*Exclusive of Survey, Design and Plant Inspection charges.

East Bay Substructure

⟦Contract Nos. 4–4-A⟧

Progress July 1, 1934, to June 30, 1935

A description of the work done under this contract, and the methods employed, will be found in the first Annual Report, July 1, 1934. No special innovations were introduced during the remainder of the work and the construction remaining to be completed at that date was as follows:

Pier E-2: Practically all work
Pier E-3: Sink from 175 feet below sea level to final elevation, clean out, seal, complete upper works, and build fenders
Pier E-4: Complete fender work
Pier E-5: Complete fender work

Deep Water Piers

Pier E-2

The combination of foundation conditions and methods of construction make the history of this pier the only one of its kind on the bridge. It is founded on firm shale and sandstone, being the only rock-founded pier in the East Bay. The formation upon which it rests is essentially of the same type and composition as the formation visible in Army Point, Yerba Buena Island, of which it is a continuation. This material is irregularly stratified, making the work of cleaning the bottom difficult but furnishing a foundation well keyed against slippage.

The mode of construction consisted of dredging out a portion of the mixed talus and sedimentary deposit which forms the bay bottom at that point, followed by driving into the rock an externally braced cofferdam of the same type employed on Contract No. 4-A. (See First Annual Report, July 1, 1934.)

All removable portions of the rock bottom were then taken by combining dredge buckets with jetting, loose fragments being washed into windrows with jets and removed by buckets until as clean a bottom as possible was obtained.

The base of the pier was then placed with bottom dump buckets, concrete being placed in the lowest points of the base first until the whole was leveled up, then all brought up simultaneously, after which the cofferdam was pumped out and concreting continued in the dry.

Contour Maps of Bedrock

An accurate contour map of the base was taken before concreting, and a relief model made for study of keying effects and possibilities of slippage.

Pier E-3

World's Deepest Pier

This pier, which with Pier E-2 forms the support for the heavy cantilever span, was ultimately sunk to a depth of 242 feet below sea level, a world's record. The average elevation of the bottom of the concrete base is 235.6 feet below sea level. The original depth contemplated was 225 feet, but dredging tests toward completion of sinking indicated the desirability of going deeper, as it appeared that the original depth would have left a wall of unstable material below the cutting edge during the process of sealing, with the consequent possibility of runs being started under the cutting edge which might not be controllable. It was decided to sink the caisson six feet further; but difficulties in controlling the exact elevation resulted in sinking a total of approximately eight feet further.

Dredging out softened and broken material from the bottom of the walls further increased the average depth. The final elevation of the cutting edge itself is 228.42 feet below sea level, 220 being the original depth planned. The greatest depth occurs in a dredging well which was excavated to −242 in exploring the stratification.

Caisson Sinking

The landing of this caisson at approximately the correct elevation proved a delicate and difficult task. Following the design, part of the upper works was constructed in advance of final sinking. Failure to land the caisson within a range of from two feet below to three or four inches above, the design elevation would have resulted in costly revisions. Owing to the great weight of the caisson, the uncertain nature of the frictional resistance of the semi-lubricant material around the sides of the caisson, and the equally uncertain manner in which the supporting material under the cutting edge habitually broke up as the caisson started to move at each sinking, the control at this point called upon the combined experience and judgment of the engineering and contracting forces. The graph made of the final stage of sinking shows that the proper manipulation of the relieving jets was a matter of split minutes, the caisson at one point sinking at the rate of two feet per minute. The precision of placing under such circumstances may be considered excellent.

The pier was completed and bridge seats finished as described in 1934 Annual Report.

Foundation Conditions

The foundation material in all the caissons, but especially in Pier E-3, presented some curious phenomena. In the greater depths the material became so resistant that clamshell buckets equipped with teeth could tear it out only in small fragments and sometimes not at all, while the submarine inspector frequently reported it as "having the feel of sandstone" under an iron rod. This same material, however, when brought to the surface, would appear as a fairly stiff blue clay with sand mixture or sand streaks, and could be easily indented with the finger. When left in the air for a few days, however, much of it would change to a typical shale rock, sometimes with sandstone seams. It appears that the material under the pressure of its native depths, is hard and comparatively free of water. (Borings show samples as low as 17 per cent in moisture.) Stiff Blue Clay

Schedule of Completion

The completion dates of piers under this contract were as follows: Pier Completion Dates

	Complete	*Contract Dates*
E-2	December 11, 1934	September 3, 1935
E-3	November 27, 1934	September 3, 1935
E-4	July 27, 1934	July 5, 1935
E-5	July 26, 1934	May 21, 1935

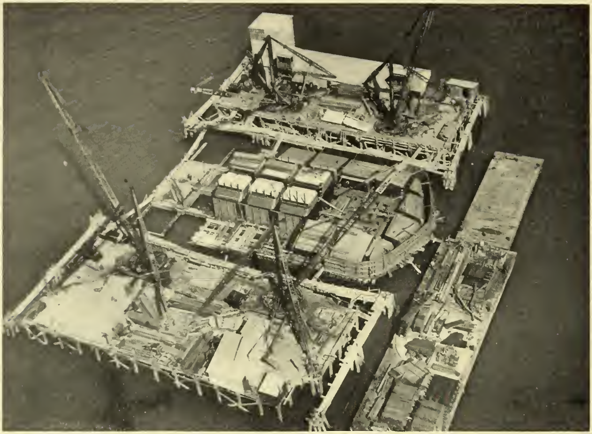
The last operation was the completion of a careful dragging of the areas of operation for the location of submarine obstructions, supplemented by submarine inspections. The contract was complete and accepted by the director on January 18, 1935.

Tideland Piers

Of this series of seventeen pile piers, described in the 1934 Annual Report, nine remained to be completed on July 1, 1934. The status was as follows:

- E-6: Not started
- E-7: Preliminary work started
- E-8: Cofferdam being driven
- E-9: Foundation piles being driven
- E-10: Foundation piles driven and seal poured
- E-11: Almost complete
- E-12: Complete except bridge seat pylons and incidentals
- E-13: Almost complete

Work was pursued on these piers without substantial change of methods or conditions, except that the partial burning of the Key Route Pier Terminus, before the commencement of the work, had placed over the site of Pier E-7 a large collection of miscellaneous pieces of steel, electric car running gears, and trucks, pipes,



Pier E-3 Sealed at Minimum Elevation –242 Showing Forms for Concrete Fender

piles, etc., which formed a serious obstruction to driving the cofferdam and excavating. Large amounts of this material were removed with considerable difficulty in order to permit the work to proceed.

As in the case of Contract No. 4, the last operation was the sweeping and examination of working areas for obstructions. No attempt was made to clear the area surrounding Pier E-7 of the debris left by the fire, other than such as was necessary for the actual construction of the pier.

The completion dates of these piers were as follows:

	Complete	*Contract Date*
E-6	December 21, 1934	January 15, 1935
E-7	December 20, 1934	March 17, 1935
E-8	October 30, 1934	February 15, 1935
E-9	October 2, 1934	January 16, 1935
E-10	September 19, 1934	December 17, 1934
E-11	July 6, 1934	November 17, 1934
E-12	July 30, 1934	October 18, 1934
E-13	July 9, 1934	September 18, 1934

Yerba Buena Island Anchorages, Piers and Tunnel

⟦Contract No. 5⟧

Progress July 1, 1934, to June 30, 1935

Description of the Work

The work under this contract consists of constructing the Yerba Buena Anchorage of the West Bay crossing composed of a cable bent and two 164-foot concrete anchor blocks with eyebar chains; excavating approximately 330,000 cubic yards of approach cuts and road changes; constructing a reinforced concrete lined tunnel, with reinforced concrete portals, 63 feet 6 inches clear in width and 540 feet long; constructing a reinforced concrete viaduct with concrete columns, girders and deck 1668 feet in length; constructing two reinforced concrete piers and six reinforced concrete pedestals; moving and reconstructing certain island buildings and utilities located on the right of way and placing bituminous treated surfacing on all road changes. 330,000 Yards Excavated

This contract was approved by the Attorney General on May 16, 1933, and the Clinton Construction Company, Contractor, began moving in equipment and constructing temporary docks on July 17, 1933. All preliminary work was completed prior to July 1, 1934.

Subcontractors

Piombo Bros. & Company	Item 1	Excavation
Daniel Contracting Company		Hauling waste
T. E. Connolly	Item 2	Tunnel
Western Construction Corporation	Item 3	Erection only
T. E. Connolly	Item 9	Tunnel except viaduct
Pacific Coast Steel Company	Item 17	Reinforcing steel
Victor Lemoge	Item 19	Electrical
Sullivan Machinery Company	Item 24	Drilling only
T. E. Connolly	Item 24	Roof grouting
William Forster and Sons	Items 21, 22	Placing only
Duncanson Harrelson Company	Items 26, 27	
D. J. and T. Sullivan		Moved buildings

Details of Construction

Cable Anchorage

All excavation was complete and concrete in the cable bent had been placed to Elevation 103 and in the walls back of the cable bent to Elevation 89 by July 1, 1934, as reported in the First Annual Report. Cable Bents Erected

Successive concrete pours were made to Elevation 118.5 and stopped there while the structural steel cable bent and rocker arms were erected and riveted. These were completed by July 1, 1935, and concreting is now in progress.

Anchor Tunnels

All excavation was completed and the concrete roof poured by June 29, 1934.

A stiffleg derrick with a 90-foot boom was erected in the center of the anchorage to hoist the eyebars from the temporary unloading dock into the anchorage proper, after which they were picked up in sets of four, properly spaced, bolted together, and lowered on rails to their proper position in the chain. Steel falsework, set on concrete pedestals, was used to hold the eyebar chains in place during and after erection, also assuring no movement during concrete operations.

Eyebars Embedded in Concrete

Placing concrete in the lower section of the north shaft began on October 11, 1934, and by December 5 the concrete had been poured to the first pin connection. The remaining eyebars will be placed during cable spinning operations. To assure no bond between steel and concrete the eyebars were spray coated with a heavy asphaltic paint, thus allowing the stress to be transferred to the girders at the bottom of the anchor tunnels.

West Approach Cut

This cut was completed March 22, 1934, and is now being used as an equipment and materials yard for the main tunnel.

Main Tunnel

On July 1, 1934, the heading of No. 1 drift was in 310 feet and No. 2 drift was in 370 feet from the west portal; both drifts were completed the last of July. The top center drift, or No. 5, was completed October 6, 1934.

Disposal of Material

The top of the lower drifts was then lagged solid parallel to the drift with a small opening left in the center which was lagged crosswise. The material from the stope was shot down on top of this, trapped into cars and hauled to the disposal chute. Stope sections 3 and 4 were completed in October, 1934, and excavation immediately began on the footings.

The footings were drilled with jackhammers, shot and mucked into cars with a dragline mucker. The north footing was completed November 20, 1934, and the south footing January 21, 1935.

The first concrete was placed in the footings on November 22, 1934, and successive pours were made until the sidewalls were completed on April 4, 1935. The forms used were of 5 ply plywood, made in panels with 2×6 studs at 18-inch centers. The panels were bolted together and 6×6 material was used to brace the forms against the rock.

Concrete was furnished by the Island Plant, hoisted in a two-yard skip to a hopper at Elevation 150, trucked to the pump and pumped to small hoppers with trunks placed along the top of the pour.

Steel Tunnel Roof Forms

The first steel rib was placed in the roof on March 1, 1935, and 115 rings were in place by July 1, 1935. The spoil from the ring excavation was allowed to fill the side drifts and the excess was hand trammed to the portals where it was later removed by the shovel.

Two sets of steel forms, 20 feet in length, were erected on top of the core for use in concreting the roof. They were arranged so that after a pour they could be lowered, moved ahead and then jacked back into position. The first roof pour was made June 3, 1935, and 80 feet of roof was in place by July 1, 1935. Concrete was pumped and chuted into place, air vibrators being used for compaction.

West Portal Yerba Buena Island Tunnel Showing Two Tunnels for Anchorage of Suspension Cables

East Approach Cut

The cut for the east approach to the tunnel was approximately 90 per cent complete July 1, 1934, and was completed on February 4, 1935.

The footing excavation from bent 35 to bent 46 was made by hand and the remainder to Pier YB-1 was made with a one yard clam, the final trimming being done by hand.

East Approach Viaduct

Work began on the viaduct September 27, 1934, and was completed from bent 35 to Pier YB-1, with the exception of the rail and truck roadway slab, by June 28, 1935. Forms were of 1×6 with 2×6 studs at 18-inch centers. Falsework was of 4×4 material with 1×6 cross braces.

Viaduct Falsework

Concrete for the viaduct was furnished by the Island Plant, trucked from the hopper at the head of the tram to a hopper near the pour, from which it was buggied into place. Electric vibrators were used to secure compaction. Forms were left in place, with the exposed portions being kept wet, for curing. Impervious membrane curing process was used for the deck.

Pier YB-1

By July 1, 1934, the caissons, concrete lining and backfill of Pier YB-1 were complete. The first pour was made in the footings on top of the caissons June 28, 1934, and the pier was completed June 28, 1935. Concrete for this pier was furnished by the Island Plant.

Pier E-1, Anchor Pier at West End of Anchor Arm for Cantilever Span

Pier YB-2

The south column of Pier YB-2 was completed May 28, 1934. The north footing was poured July 5, 1934, and the north shaft completed on July 25. The backfill was completed August 9. Concrete for this pier was furnished from barges.

Pier YB-3

The north shaft of Pier YB-3 was completed May 10, 1934. Excavation was completed for the south footing August 6, and the footing poured August 14, the whole pier was completed August 30, 1934. Concrete was furnished from barges and trucked to the site. The backfilling was completed September 4.

Pier YB-4

As reported in the First Annual Report, Pier YB-4 was completed May 10, 1934.

Pier E-1

West Anchor Pier for Cantilever

Pier E-1 was poured to Elevation +121 prior to July 1, 1934, and by September 28 Elevation +169.75 had been reached. At this elevation it was necessary to place the anchor shoes and pre-stress the eyebars. This was done when the traveler erecting the YB spans reached the pier. Concrete work was resumed on July 8, 1935, with the pouring of the eyebar wells, and the pier was completed on July 12, 1935.

The backfilling is approximately 80 per cent complete.

Roads, Utilities and Buildings

The roads which serve as approaches to the bridge for government activities on the island are designated as D, E, F and G. These have all been graded and roads F and G surfaced with an oil mix, and curbs and gutters placed. The lower parking area in front of the Marine Barracks has also been completed with surfacing, curbs and gutters.

All utilities effecting construction have been relocated and buildings on the right of way have been either moved or replaced. All replaced buildings have been demolished and the sites cleaned.

Summary

All contract items for construction on Yerba Buena Island are up to or ahead of the Contractor's schedule and the island portion of the project is now approximately 70 per cent complete.

West Bay Superstructure

⟦Contract Nos. 6–6-A⟧

Progress July 1, 1934, to June 30, 1935

Resume of Preceding Work

As noted in the report for the year ending June 30, 1934, the contract for the West Bay Superstructure was let on May 16, 1933, to the Columbia Steel Company. The contract provided for the construction of the twin suspension bridges between San Francisco and Yerba Buena Island, a total length of approximately two miles. The contract cost is estimated to be $13,732,500, of which 27 per cent is for the towers, 33 per cent for the suspension cables, and 40 per cent for the suspended spans and immediate approaches. The principal materials required include some 65,000 tons of tower and suspended span steel, about 21,000 tons of cable wire and accessories, and approximately 20,000 cubic yards of concrete deck. **13 Million Dollar Contract**

The first report also noted that Tower 2, the most westerly tower, was practically erected and that nearly half of the field connections had been riveted. Of all steel required for Contract No. 6, about 55 per cent had been rolled, 40 per cent had been shop fabricated, 14 per cent had been received in the yard at Oakland Mole, and 5 per cent had been erected by July 1, 1934.

Erection of Tower 2

Work on the suspension bridge towers has continued throughout the first year. The two saddle castings for Tower 2 were hoisted to a temporary position on the top strut of the tower in July, completing the work of the hammerhead cranes at this point. Riveting on the tower was completed late in August. The top of the tower was leveled by special bevel shims, then the saddle castings were jacked over into position ready for cable spinning. All steel was sandblasted and painted with red lead before erection. Beginning in the middle of August and continuing until October 20, a second coat of brown paint was applied to the tower. Third and fourth coats are provided for by Contract No. 9, the details of which are covered later in this report. **Tower Erection**

Erection, Riveting and Painting of Tower Units 3-6-5

Erection of Towers 3, 6 and 5, in this sequence, proceeded as previously described for Tower 2, all being completed ready for cable spinning by June 30, 1935, except that Tower 5 had received only 36 per cent of its coat of brown paint. Towers 3 and 5 are heavier than Towers 2 and 6 and about 45 feet higher, or to Elevation 498.6 feet at base of cable saddles. The increased heights are due to the greater navigation clearances required in the central spans and result in a grade of the upper bridge deck rising from Elevation +155 feet at the San Francisco Anchorage to Elevation +260 feet at the Center Anchorage, then dropping to Elevation +175 feet at Yerba Buena Island Anchorage.

The following table shows size, cost and completion dates for the four towers:

	Tower 2	*Tower 3*	*Tower 5*	*Tower 6*
Height (top of saddle)	460	504	504	460
Weight (tons)*	5,130	5,527	5,527	4,975
Cost	$780,074	$839,869	$839,690	$756,445
Major erection completed	Prior to July 1st	August 31, 1934	February 21, 1935	October 19, 1934
Riveting complete	August 25, 1934	November 23, 1934	May 21, 1935	January 22, 1935
Painted, second coat*	October 24, 1934	February 26, 1935	36%	May 7, 1935

* Priming coat completed at Oakland yard.

Progress at times was very rapid, 556 tons of steel being raised into place during one day at Tower 5. On three other days erection exceeded 500 tons per day at this unit. The major erection of Tower 6 above base plates was accomplished in 17 successive working days or 25 elapsed days. On several occasions, riveting gangs accounted for over 600 rivets of 1⅛ inches diameter in one 8-hour shift, one gang establishing a record of 636. At Tower 3, major riveting (110,911 rivets) was completed in 48 consecutive working days (71 elapsed days). Over one-half million field rivets were required for the tower units.

Crew Drives 600 Rivets in 8 Hours

Painting of the steel, usually considered as a minor item, assumed a position of considerable importance on this work, where steel surfaces total 1,248,000 square feet on the West Bay towers alone, which required 1823 gallons of second coat paint. It is of note that painting of the second coat on Tower 6 was completed in 23 working days.

Bent and Anchorage Erection

Erection, riveting and painting of the two cable bents, ready for cable spinning, was completed during the year. As soon as concrete work, being placed under other contracts, had been finished to the proper stage, these cable bents, ashore at San Francisco and on Yerba Buena Island, respectively, were erected by guy derricks in the inclined position required by the slopes of the suspension cables at those points.

A-frame Raised

Beginning in February, the heavy steel A-frame and the hold-down eyebar system was erected at Pier W-4, the Central Anchorage. About 2000 tons of steel were required for this purpose, much of which is embedded deep in the concrete of the central anchorage block. Close cooperation between foundation and superstructure contractors was necessary at this unit in order to complete the concreting under Contract No. 2 in conjunction with the erection of steel under Contract No. 6.

The hold-down eyebars were pre-stressed with powerful hydraulic jacks so that there will be practically no elongation of these parts under bridge loads. Riveting of the nickel-steel A-frame with manganese-steel rivets made the project ready for cable spinning by June 12, 1935.

Cable Spinning—San Francisco to Central Anchorage

Cable Spinning Starts

Cable spinning preparations were preceded by the erection of catwalks between anchorages at San Francisco and Pier W-4. The walks were placed just below the spinning position of each cable, and were constructed during the period from March 20 to June 15, 1935. Each catwalk is supported by four wire ropes of $2\frac{1}{4}$ inches diameter, the individual ropes having a breaking strength of not less than 400,000 pounds. These ropes will later be cut up into lengths for use as suspender ropes to support the stiffening trusses.

In erecting the catwalk ropes, trolley lines were first stretched across between tops of towers, bents and anchorages, while navigation was detoured from below, and the catwalk ropes pulled across clear of water or obstacles. It is of interest to note that each main span rope weighed nearly eleven tons. All ropes were carefully adjusted to the correct sag so that the walk would be about two and one-half feet below the cable during spinning and were erected by May 22, 1935.

Catwalks of Wire Mesh

Catwalk floor sections, 100 feet in length, were prepared in advance of erection. These sections consisted of heavy 2-inch spread wire mesh nailed to timber floor beams. The sections were hoisted to the tower tops, floor beams bolted loosely to the cables, ends of mesh joined, and the sections then skidded down to position. The mesh was then stretched, bolts tightened and the handrails erected to form a walkway which offers but little resistance to the wind, yet is stable and affords good traction, an important consideration where maximum grades approach 38 per cent.

Crosswalks were erected between the two catwalks for communication purposes. They also serve to stiffen the walks against the wind. Further rigidity is obtained by a storm cable system of steel wires arched over the spans by cable ties to catwalk ropes and with ends attached to the tower bases. Navigation lights are hung on the storm cable arch to indicate safe channels and warn of restricted clearances adjacent to the towers.

Details for Hauling Cable Wire

The cable spinning machinery and equipment were assembled at the anchorages and along the catwalk, beginning February 20 and finishing June 14. Principal items included the hauling rope, or spinning system, and the wire unreeling system. The former included continuous 1-inch wire rope for each cable, supported 15 feet above the catwalk by "gallows frames" mounted every 240 feet on each walk, with drive motors at Pier W-4 and at the San Francisco Anchorages. Idler sheaves and a counterweight system were also installed at the San Francisco Anchorage to take up slack. Two spinning wheels were erected at opposite points on each endless hauling rope, so that one wheel would travel east from San Francisco to Pier W-4 while the other was traveling west over the same distance. The wheels were four feet in diameter and each had two V-shaped grooves on the rim. On any one trip for one cable eight wires or 46,000 lineal feet would be placed. The wire unreeling system, placed at each anchorage for each cable, included a rack to support four 16-ton reels of cable wire, a drive system for starting the reels, automatic braking system to stop the reels promptly and avoid wire tangles, and a floating sheave tower

to maintain a tension in the wire during spinning. Elaborate telephone and signal controls were provided to properly coordinate the work, which was spread out over about 6000 feet.

Governor Merriam Starts Spinning

Spinning on the south cable, West suspension spans, started with ceremonies attended by Governor Merriam and his official party on June 15, 1935. North cable spinning did not start until June 28, thus permitting alternate periods for strand adjustments following the spinning of each group of four strands, called a spinning set-up. Shims are provided at the strand shoes for adjusting each strand after it is complted. The individual wires of a strand are adjusted as they are spun.

The progress of cable spinning to the end of the fiscal year, June 30, 1935, was not rapid, as much of the work was of experimental nature with new equipment devised for this bridge. On that date, 195 tons, or about 1 per cent, of the cable wire had been spun. It is expected that the cables for the west bridge will be completed in October and spinning of east bridge cables, Pier W-4 to Yerba Buena Island, started before the end of the calendar year.

General

Of all steel required for the work, 93 per cent had been rolled, 74 per cent shop fabricated, 52 per cent received in bay region storage and painting yards, and 34 per cent has been erected. Subsequent progress will be extremely rapid. Spinning the cables for the east bridge will proceed at the same time that the west bridge suspended spans are being erected.

East Bay Superstructure

⟦Contract No. 7⟧

Progress July 1, 1934, to June 30, 1935

General Description

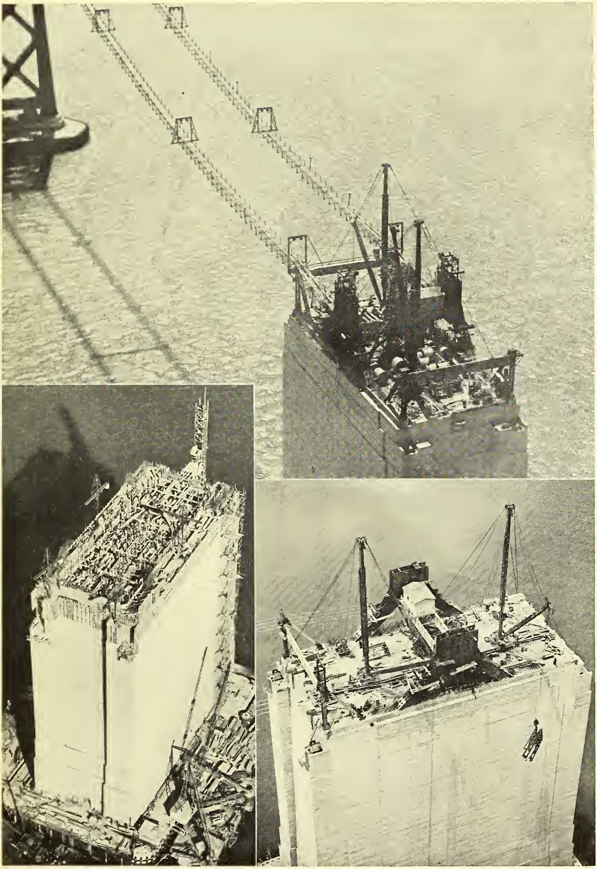
Contract No. 7 includes all the steel superstructure to be placed from the tunnel on Yerba Buena Island to the Mole, a total of 116,700,000 pounds of steel. This steel superstructure embraces four 288-foot simple spans on Yerba Buena Island from Pier YB-1 to Pier E-1; the cantilever span of 1400 feet, with its two anchor arms of 508 feet each, extending from Pier E-1 to Pier E-4; five 504-foot through spans from Pier E-4 to Pier E-9; fourteen 288-foot simple spans from Pier E-9 to Pier E-23; and ten girder spans from Pier E-23 to Pier E-33, which brings the upper deck down to the Mole. All necessary steel towers supporting these spans are, of course, included.

Span Weights

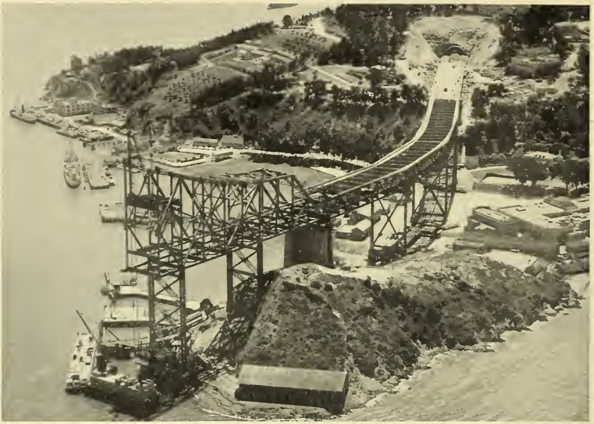
All of the 288-foot spans are simple deck truss spans with the lower deck supported at the bottom chord and the upper deck supported at the top chord. Each of these spans weighs approximately 2,000,000 pounds.

The 504-foot spans are of the through truss type, each having a weight of 4,600,000 pounds. The roadways are carried through the lower half of the trusses.

The cantilever span, with a clear length of 1400 feet, is the third longest span of this type in the world, being exceeded in length only by the Firth of Forth in Scotland and the Quebec Bridge across the Saint Lawrence. The trusses of this



Three Views of Concrete Center Anchorage for the Twin Suspension Bridges



West Anchor Arm for Cantilever Span June 30, 1935

span have a minimum depth of 97 feet and a maximum depth of 192 feet measured from center to center of chords, and it is elevated 190 feet above the water at the lowest point to provide a shipping channel. The two decks are carried through at the lower part of the trusses.

In all of these spans the trusses are spaced approximately 66 feet apart and provide a clear roadway of 58 feet with a narrow walkway along each side.

The steel towers supporting these spans are of the flexible type with the exception of E-9, which is a rigid four-legged tower and forms the anchorage for the 504-foot spans, and the two curved 288-foot spans at E-9 and E-10.

Expansion Joints

All expansion for the four 288-foot spans on Yerba Buena Island is taken by a divided, or double, tower at Pier YB-3. The expansion for the cantilever and the 504-foot spans is taken by a divided tower at Pier E-4. At this point provision has been made for a total of four feet of expansion. Another divided tower at Pier E-11 takes the expansion of the 288-foot spans from E-9 to E-16. Expansion of spans E-17 to E-22 is taken by rockers on top of the concrete piers, there being in this case no steel towers.

Operations on Main Structure

The Columbia Steel Company have the general contract under which this superstructure is being fabricated and erected. This has been divided into two sections at Pier E-4, and all that part of the steel work east of and including the tower at E-4 has been sublet to the McClintic Marshall Corporation, while that part west of E-4 to Yerba Buena Island has been sublet to the American Bridge Company.

Erection of the 288-foot spans, under McClintic Marshall's contract, began at the Mole and proceeded westward. These were erected by the cantilever method, using in most cases only one falsework bent, which was placed under the center of the span, and the trusses were cantilevered from each pier to the falsework and then from the falsework to the next pier. Each span was tied back to the preceding span at the top chord to support the cantilevered portion.

Falsework Supports

Erection was accomplished with a traveler, carring two stiff-leg derricks with 87-foot booms, riding on four rails along the upper deck. Steel piling and framing was set by a derrick barge and removed by a special pile extractor riding on upper deck. Riveting was done in the usual manner, air being supplied by four diesel compressors mounted on a barge.

The 504-foot spans were erected by the same equipment as was used on the 288-foot spans above except that the booms on the traveling derricks were lengthened to 100 feet. Five falsework bents were used to erect these spans, spaced two panels apart. The cantilever method of erection was not practical on account of eyebar bottom chords.

The 288-foot spans on the Island were erected on two falsework bents, one at the quarter point and one at the center of the span. This was made necessary by the fact that all these spans were on a curve. From the center falsework the trusses were cantilevered to the next pier. Erection was accomplished by a traveler, carrying two guy derricks with 90-foot booms, moving along on skids on the upper deck. The engines were not carried on the spans but were stationed on the island at the westerly end of the spans. No pile falsework was driven except for span YB-1 and these piles were burned off instead of being pulled. All other falsework rested on timber cribbing or concrete bases.

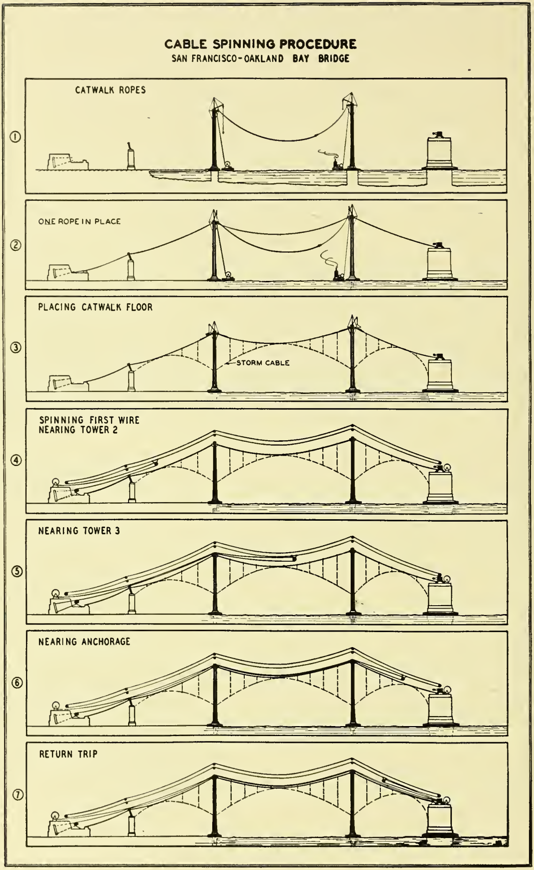
Two-derrick Traveler

The erection of these four spans as well as the west anchor arm of the cantilever proceeded slowly due to the fact that all material had to be unloaded from barges to railroad trucks and hauled over a temporary track to a point where the derricks could reach them.

The west cantilever anchor arm was erected on three falsework bents located at panel points 2, 6 and 8 numbered westerly from Pier E-2. Temporary members were inserted at the middle points of the trusses to take the compression out of the top chord while acting as a simple truss over this falsework. The bent at 8 rested on timber cribbing, that at 6 on concrete piers and at 2 on steel piling.

Cantilever Anchor Arm

For erection, a traveler was provided with two guy derricks having 100-foot booms and moving on skids. This traveler operated on the upper deck, beginning at Pier E-1 and working east. When the truss had been erected to panel point 2 and was resting on the falsework at that point, the traveler was drawn back to panel point 5 and raised to a point near the top of the truss where it traveled on temporary floor beams. This was necessary in order to reach the top of trusses at their peak over Pier E-2. The engines operating these derricks were placed on the lower deck of span YB-4. The guy lines for the derricks were fastened, at the west to the top chord of span YB-2, and at the east to the tower bases at Pier E-4, and were held above the channel by two steel masts, 120 feet long, resting on the slab at Pier E-3.


CABLE SPINNING PROCEDURE
SAN FRANCISCO-OAKLAND BAY BRIDGE
CATWALK ROPES
①
ONE ROPE IN PLACE
②
PLACING CATWALK FLOOR
③
STORM CABLE
SPINNING FIRST WIRE
NEARING TOWER 2
④
NEARING TOWER 3
⑤
NEARING ANCHORAGE
⑥
RETURN TRIP
⑦

Key Mole Girders

The section of the steel erection located on the Key Mole, being of different type from the trusses, was carried on as a separate unit after most of the trusses had been erected.

The Mole spans are located at the easterly end of the 288-foot trusses and consist of steel girders for supporting the top deck resting on Piers E-23 to E-33, inclusive, and of steel railings on concrete Spans E-33 to E-38, inclusive. This section of the structure comprises the ramp by which the top deck is brought to ground level. The lower deck at this point is concrete, having been constructed under Contract No. 8. **Structure of Steel**

The work consisted of erecting ten spans, each 82 feet 6 inches in length, making a total of 825 feet, and the erection of a north and south railing on 250 feet of concrete deck. The width of roadway between curbs is 58 feet plus walkway 1 foot 10 inches wide on each side.

The structure consists of cross girders resting on concrete columns into which two longitudinal girders are framed near the ends. These four girders form a box which is split into thirds by two floor beams extending transversely between the longitudinal girders. Thirteen lines of equally spaced 18-inch I-beam stringers extend longitudinally between floor beams and cross girders to form the support for the concrete floor. A combination of steel plate curb, walk and hand rail surmounted with a 4-inch pipe rail is placed on either side and fastened to the longitudinal girders and floor beams. Practically no lateral bracing has been used, the concrete decks furnishing the required lateral stiffness.

The spans have been fabricated in pairs, being continuous over one support with an expansion joint at every second cross girder. This joint is swung in a saddle supported on the cross girder, the sliding member consisting of a semicircular bearing block with the flat side down and curved top side engaging in the bottom plate of the longitudinal girder. This joint takes care of both vertical deflection and horizontal movement. The deck joints consist of steel plate and angle dams bolted to the cross girder on one side and the stringers on the other side of the joint. They carry the usual lugs for embedment in the concrete.

The first equipment for this work was brought to the site May 14, 1935, and the first steel was placed May 22. The work of riveting was completed on July 8 and the clean up on July 13, 1935.

Hoisting Rig The equipment used was simple and efficient. The hoisting rig consisted of a guy derrick mounted on two I-beams forming a transverse sill which reached from one longitudinal girder to the other. A fabricated tail skid extended to the rear preventing overturning in this direction. Guys from the top of the 90-foot mast extended down to the ends of the sill with two additional guys forward fastening to adjacent pier anchor bolts and two extending to the rear fastening to the floorbeams. The boom was 80 feet long. The mast rotated through 360 degrees so that the boom could be used forward or back by a simple maneuver under the guys. The derrick moved forward on skids resting on top flanges of the longitudinal girders.

Derrick Skidded Power was furnished by a two-drum 40 horsepower steam hoist set on skids just off the concrete deck at Pier E-39 for the start of the work. The derrick was skidded ahead after the erection of each span, girders being placed with the boom

Aerial View of East Bay Crossing, March 15, 1935

in the forward position and sidewalks being placed with the boom to the rear. Sufficient cable was used on the hoist so that only three moves of this unit were necessary as against ten moves of the derrick.

The riveting followed closely on the erection, one gang doing most of the work until the last four spans, when two gangs were used. Floats were hung from the outside and inside of the girders for work on main connections while simple board seats took care of work on stringer connections. Work was good and cutouts nominal.

The total quantities in this portion of the work were approximately 1,800,000 pounds of structural steel, 7500 rivets and 3300 bolts.

Progress and Status of Erection

McClintic Marshall began preliminary work on their part of the contract on July 30, 1934. The first piece of steel was raised on August 14, 1934, and was the beginning of Span E-22 at the Mole.

On July 1, 1935, erection had proceeded to the center of Span E-4, including the Mole girder spans, the fourteen 288-foot spans and four and one-half of the five 504-foot spans, a total of about 28,000 tons of steel in ten and one-half months. To Center of Span E-4

The American Bridge Company began preliminary work on their part of the contract on October 24, 1934. Actual erection, however, did not begin until December 4, 1934, when the shoes for Span YB-1 were set.

On July 1, 1935, erection had proceeded to and including panel point LA-2 of the west anchor arm of the cantilever. The four YB spans and the cantilever to this point represent a weight of about 8000 tons.

Concrete Paving

General Description of Paving on Steel Spans

A subcontract with the Bates & Rogers Corporation includes the concrete paving on the upper deck of the bridge from Pier YB-1 on Yerba Buena Island to Pier E-33, located near the end of the Key Route Mole in Oakland; and on the lower deck from Pier YB-1 to Pier E-23, located at the end of the Mole.

The upper deck pavement under this contract is 11,081 feet long, 58 feet from curb to curb, and six inches thick with a 2-inch crown. The pavement is divided into six traffic lanes by means of 4¼-inch square white tile traffic lane markers. Light weight concrete, weighing approximately 100 pounds per cubic foot is being used on the deck in order that lighter structural steel members could be used. Tile Mark Lanes

The lower deck pavement is 10,156 feet long, 31 feet from curb to curb, 6½ inches thick, with 1½-inch crown. This pavement is divided into three lanes to accommodate truck traffic, but tile traffic lane markers were not used on this deck. Ordinary concrete, weighing approximately 155 pounds per cubic foot was used. The remainder of the lower deck of the bridge, allotted to electric train traffic, was not paved. Paving Weight

The East Bay superstructure, including paving, was let under a single contract, with a close time limit, considerably overlapping the time limits of the contract for the east approach. Therefore, it was necessary to begin paving operations without waiting for completion of the east approach and the paving contractor carried on

his operations at widely separated points, over a long line, in order to stay outside the limits of the east approach contract. These operations were divided into three distinct groups: batching, mixing, and placing concrete, connected by a transportation system.

The batching plant was located at the south edge of the State right of way opposite stations 290 and 291. The mixing plant was located on a timber dock at the south side of the bridge near Pier E-23. The distance from the batching plant to the mixing plant was 1700 feet. From the mixing plant concrete was transferred by rail to the point of placing.

Batching Plant

Cement Bin of 350 Barrels

The nucleus of the batching plant was a Johnson Automatic Batch Weighing and Interlocked Concrete Plant. It consisted essentially of six aggregate bins, an Octo cement bin, scales, weighing hoppers, and belt conveyor. The aggregate bins were in the form of inverted square pyramids of 12 cubic yards capacity each, and arranged in a single line from the east end of the plant. The cement bin was in the form of an inverted octagonal pyramid of 350 barrels capacity and was located at the west end of the plant. Eight aggregate bunkers were located parallel to and on the north side of the batching plant for storage. A cement pump, water pump, air compressor, and an American locomotive crane completed the major equipment.

Each aggregate bin discharged into a weighing hopper of 28 cubic feet capacity, and then to a belt conveyor which carried the aggregates to the west end of the plant and discharged into cars below. The cement bin discharged into a weighing hopper and then directly into the same car with the aggregates.

The plant was electrically controlled and air operated throughout except for one bin, which was hand operated. This bin was used only for topping sand when pouring upper deck concrete. There were seven main circuits controlling the cement bin and aggregate bins and operated off the control panel. There were six charging circuits: one for each of the five aggregate bins, one for the cement bin, and the discharge circuit common to all.

Electric Quantity Controls

In operation, charging switches were closed at the control panel corresponding to the cement and to each bin of aggregate desired in the mix. This opened the gate in the bottom of each bin. Cement and aggregate flowed into the weighing hoppers until the proper weight in each hopper was reached, at which time the scale beams tilted, causing the gates to close. A light glowed on the control panel for each hopper being filled and went out when the hopper was ready to be discharged. When all lights were out the operator opened the charging switches and closed the discharge switch. This opened the gate at the bottom of each weighing hopper allowing the aggregate to drop to the belt conveyer. After the batch was discharged on to the conveyor the discharge switch was reversed, closing the gates at the bottom of the weighing hoppers, the charging switches were closed and the operation repeated.

All concrete was proportioned by weight using the absolute volume method. The average proportions of aggregates, by absolute volume, used for concrete on the lower deck were 38 per cent concrete sand, 20 per cent ¼-inch to ¾-inch gravel and 42 per cent ¾-inch to 1½-inch gravel. Six sacks of cement were used per cubic yard of concrete. The water-cement ratio averaged 0.72 and the average compressive strength in 28 days was 4000 pounds per square inch.

The average proportions of aggregates, by absolute volume, used for concrete on the upper deck were 8 per cent Antioch sand (a special fine sand), 4 per cent concrete sand passing 1/8-inch screen, 28 per cent lightweight sand, 26 per cent 1/4-inch to 3/4-inch lightweight rock, and 34 per cent 3/4-inch to 1-inch lightweight rock. Six and one-half sacks of cement and 20 pounds of celite per cubic yard of concrete were used in the bulk of the upper deck paving. The average water-cement ratio was 0.80 and the average compressive strength in 28 days was 3100 pounds per square inch. Ratios of Aggregates

The contractor's crew at the batching plant consisted of one foreman, one crane operator, one cement pump operator, one plant operator and four laborers.

The State maintained an engineer at the batching plant, when paving was in progress. His duties were to observe the general operations of the plant, set and check scale beams on weighing hoppers, and make the various physical tests of aggregates for design and control of the concrete mix. Screen analyses and specific gravity tests were made of each shipment of aggregate and moisture and absorption tests were made periodically during the day for controlling the mix. Aggregate Tests

Aggregates

Aggregates used for the lower deck concrete were concrete sand passing a No. 3 sieve, 1/4-inch to 3/4-inch gravel, and 3/4-inch to 1 1/2-inch gravel. These aggregates were furnished by the contractor and obtained from a commercial plant near Livermore.

Aggregates used for the upper deck concrete were Antioch sand, concrete sand passing 1/8-inch screen, lightweight sand, 1/4-inch to 3/4-inch lightweight rock and 3/4-inch to 1-inch lightweight rock. Concrete sand, passing a No. 3 sieve, was used for the 1/4-inch topping placed on the base course of lightweight concrete. The lightweight aggregates were manufactured of shale by means of burning in a rotary kiln. All aggregates for the base course of the upper deck pavement were furnished by the State and purchased from the Gravelite Company at Richmond, California. Lightweight Aggregates

All aggregates were delivered by rail to the batching plant. The aggregates were unloaded from the cars to the bunkers or the plant hoppers as needed by means of a locomotive crane. This crane had a capacity of 17,000 pounds at 30-foot radius, and was equipped with a 60-foot boom and a one cubic yard clamshell bucket. All lightweight aggregates were sprinkled with water at the batching plant until they were thoroughly wet.

Cement

Cement was delivered in bulk in box cars to the batching plant. It was pumped from the car into the Octo bin by a Fuller-Kenyon cement pump which delivered 60 to 70 barrels of cement per hour through a 4-inch line. The lift was approximately 32 feet.

Water

A 15,000 gallon wood-stave water tank was located west of the batching plant and approximately 35 feet above the ground. This was for the purpose of furnishing an unfailing water supply to the mixing plant under a nearly constant head. Water was pumped to the tank from a city main supplying the Key System Pier.

A triplex road pump was used, powered by a 40 horsepower engine, and delivered 45 gallons per minute. Another pump of approximately half this capacity was used as a stand-by.

Mixing Plant

The mixing plant consisted of the following equipment:

Smith one-yard concrete mixer with automatic timing and a 45-gallon tank with overflow pipe for measuring water.

American two drum hoisting engine with 100 horsepower boiler and auxiliary steam winch.

Eight-foot Insley steel tower and a one cubic yard Insley skip.

Shed for storing extra cement.

Dump Cars Serve Concrete

Materials were brought in dump cars from the batching plant, each car containing one batch and usually four cars to the train. Cars were dumped directly into the mixer skip. Each batch was mixed for two minutes and then discharged into the tower skip and hoisted to the concrete hopper on the upper deck. Twenty pounds of celite was added to each batch (1 cubic yard) at the mixer.

Forms

Plywood Paving Forms

The forms used on the lower deck were 5-ply plywood panels 36 inches by 51 inches and $\frac{3}{4}$-inch thick, supported by frames of 2 inches by 4 inches on 18-inch centers. The frames were supported by 2-inch by 4-inch wales hung from the top flange of the floor stringers with $\frac{3}{8}$-inch rods. These rods were supported by means of a $\frac{3}{8}$-inch by $\frac{3}{4}$-inch channel at 3-foot centers across the top of the floor stringers. The plywood panels were framed approximately $\frac{1}{8}$-inch below the underside of the flange of the floor stringer, and this $\frac{1}{8}$-inch gap was filled with a wood strip. The plywood was not nailed to the 2-inch by 4-inch frames, making them easy to dismantle, and frequent oiling made it possible to use them over and over again.

The panels used for the upper deck forms were the same as used on the lower deck except they were $68\frac{3}{4}$ inches long. The 2-inch by 4-inch frames were supported by 2-inch by 4-inch spreaders on the lower flange of the floor joists. The plywood panel was framed $\frac{3}{8}$-inch below the under side of the joist flange and this $\frac{3}{8}$-inch gap was filled with a sponge rubber strip. Forms were stripped seven days after placing concrete.

Reinforcing Steel

Paving Reinforcing Trusses

The main reinforcing in the upper deck consisted of welded trusses $4\frac{1}{4}$ inches outside depth, spaced at 8-inch centers, and placed longitudinally. The main reinforcing in the lower deck consisted of trusses $4\frac{3}{4}$ inches outside depth, spaced at $7\frac{1}{2}$-inch centers, and placed transversely. Each truss was welded to the floor joists on the upper deck and to the floor stringers on the lower deck. Four electric welding machines were used for this work. The trusses in both decks were spaced with $\frac{1}{2}$-inch round deformed bars on 12-inch centers in the top and bottom of slab. Extra $\frac{1}{2}$-inch round deformed bars were placed over floor beams on both decks.

Placing Concrete

When all structural steel was in place and before any other dead load was applied, levels were taken for the purpose of setting construction joint angles and the steel track for the finishing machine. The proper thickness of shims was

Toll Plaza, Maintenance Building and Garages

then computed to bring construction joint angles and track on curbs to the proper elevation allowing for necessary camber and deflection. For construction purposes, the upper deck was divided into three lanes separated by two 6-inch by 3½-inch by ⅜-inch angles back to back. The lower deck contains no longitudinal construction joints. The construction angles were brought to grade with steel shims and bolted in place. The ¾-inch by 5-inch flat steel track on the curbs was shimmed to grade and tack welded to curb at approximately six foot intervals. Steel shims were placed under the track at one foot intervals to eliminate any deflection.

Paving Schedule

The general schedule followed in placing concrete was to pour the lower deck for 800 to 1000 feet; then pour the center, south and north lanes of the upper deck in the order named. The concrete was transferred from the mixing plant hopper to the point of placing by a train of four hopper cars operating on the upper deck. The average rate of pouring concrete was about 18 cubic yards per hour.

Adjustable Screeds

When the lower deck was being poured, the concrete was discharged directly from the hopper cars on the upper deck to a hopper on the distribution gantry on the lower deck, and was transferred from the distribution gantry to the deck by buggies. The concrete was vibrated and struck off to grade by a 31-foot finishing machine. This machine consisted of two steel screeds followed by a belt float. Screeds and belt moved back and forth across the pavement on a 3½-inch throw from the center line. The screeds were adjustable for crown and slope. Six electric vibrators were built in the front screed, the current being generated by a separate gasoline motor. After the final screeding with the finishing machine the concrete was floated with a bull float and given a broom finish.

The curing was accomplished by applying an impervious membrane to the finished concrete surface.

The concrete for the upper deck was transferred from the hopper cars by buggies to a distribution bridge and dumped in the forms. The base course, 5¾ inches thick, of lightweight concrete, was vibrated and struck off with a finishing machine. This machine was of the same general construction as the one used for the lower deck. The front screed, containing three electric vibrators, was set ¼-inch lower than grade and was used both for vibrating and striking off the base course.

Topping

The ¼-inch topping (1 part cement to 3 parts of concrete sand by volume) was placed from 1½ to 2 hours after placing the base course, depending upon the weather conditions and the consistency of the base course. The top course was struck off twice with the back screed and once with the belt which operated behind

the back screed. The concrete surface was then hand floated where necessary and given a broom finish.

Traffic stripes were made by placing rows of 4¼-inch by 4¼-inch by ⅝-inch white tile in the concrete. This tile setting operation followed just behind the finishing while the concrete was still fresh. A double row of tile on 6⅜-inch centers, staggered, was placed in the center of the roadway. Two single rows of tile on 8½-inch centers were placed on each side between the center of the roadway and the curb, making six lanes for traffic on the upper deck. Special tile setting bridges were constructed for placing the tile, which were adjustable for alignment and grade and contained metal templates for spacing the tile.

Paving Cured

The impervious membrane method for curing the concrete was applied immediately behind the tile setting machine.

Radios were at the batching plant, the mixer, and on the deck so that the men in charge of placing the concrete could communicate directly with the plants.

Two locomotives with four dump cars each were used to haul the batched aggregates from the batching plant to the mixing plant. Two locomotives with two hopper cars each were used to haul the concrete from the mixing plant to the point of placing.

The reinforcing steel was delivered on barges to the mixing plant dock and then transferred to the point of placing by rail on the upper deck.

Status of Work July 1, 1935

The paving on this contract was started January 10, 1935.

Paving Completion Dates

On July 1, 1935, both upper and lower decks were paved from Pier E-23 to Pier E-8, a distance of 4638 feet. This is 41.8 per cent of the paving on the Oakland side of Yerba Buena Island and 21.3 per cent of the paving on the entire bridge.

Personnel of Contractor

Bates & Rogers Construction Company, a subcontractor of the American Bridge Company, has the paving contract. The personnel of the Bates & Rogers Construction Company is as follows: W. A. Rogers, president; C. V. Burghart, vice president and treasurer; F. L. Copeland, vice president; L. C. Rogers, vice president; D. B. Cassell, secretary and assistant treasurer.

Concrete Girder Spans on the Mole

⟦Contract No. 8⟧

Progress July 1, 1934, to June 30, 1935

On July 1, 1934, approximately 22 per cent of the value of the work on this contract, which provided for construction of reinforced concrete piers and spans on the Mole, had been completed, while about 34 per cent of the time had elapsed. None of the piers had been completed at this time and work had been confined to the part of the contract between Piers E-23 and E-25 which were over the water. The work was hampered to some extent by a week's shutdown between July 21 and 28 due to the general strike of that year.

The first pier to be completed was Pier E-23 on July 14 and by the first week of September Piers E-23 to E-25 were complete, or practically so, and the decks completed except rails and curbs from Piers E-23 to E-24, inclusive.

Status October 20th

From Piers E-34 to E-39, inclusive, the pile driving was done without preliminary excavation, the piles being driven from the original surface of the ground and tops driven to the required footing elevation with a follower. The final elevation of heads was approximately six feet below ground surface. This additional penetration did not materially affect the driving resistance of the piles as all driving in this area (Piers E-34–E-39) was relatively easy and bearing values as given by driving data were generally low, although averaging within the specifications. Pile Driving

Progress was such that all piers to Pier E-29 and deck slabs to Pier E-28 were completed by December 29, 1934. There remained the portion of the upper deck ramp from Pier E-33 to Pier E-39 to be completed. The span at Pier E-33 was poured January 11, 1935, and all of this section completed by February 6, 1935.

The contract work was completed February 26, 1935, and the final cleanup completed March 29.

Painting West and East Bay Superstructures

[Contract No. 9]

Progress July 1, 1934, to June 30, 1935

Contract No. 9, which provides for painting of steel in both West and East Bay Crossings of the Bay Bridge, was let to the Bridge Builders, Inc., on December 13, 1934, for a contracted cost of $835,000.

On the West Bay Crossing from San Francisco to Yerba Buena Island, the cost for painting is estimated at $498,600, which covers about 24,000 tons of tower steel, 39,000 tons of span steel and 22,000 tons of cables and accessories. The tower steel under this contract will be given the third, and the fourth and final coat of paint; the span steel will receive the last three of the four coats, and cables and accessories all four coats, in addition to cable paste under the wire wrapping of the main cables. The final coat of paint for all steel will be aluminum. Aluminum Over Lead

Painting of West Bay towers was started on March 11, 1935, at Tower 2. The third coat was completed April 25 and the fourth coat practically finished by June 30, 1935. Third coat paint at Tower 3 was 15 per cent complete by June 30. A total of 4.7 per cent of the West Bay painting was completed during the year at a cost of $23,000.

Painting progress during the coming year will be in step with erection of steel which promises to be rapid.

On the East Bay crossing section the first, or primer, coat of paint was applied by brush in the yards of the fabricating company after the steel had been weathered and sand blasted. After erection the rivet heads and abraded places were spot painted to provide an unbroken primer coat. This primer coat and the spotting was included in Contract No. 7 and was done by the fabricating and erecting companies.

The second and third coats of paint under Contract No. 9 were applied with brushes except in lattice members and where it was difficult to use a brush. In such places spray guns were used followed by a brush to insure a smooth even coat. The fourth and final coat was applied by the use of spray guns exclusively.

The first, or primer, coat was a very heavy pure red lead paint. The second and third coats were also red lead but contained a small amount of lamp black to distinguish them from the preceding coat. The fourth coat is aluminum, containing two pounds of aluminum to a gallon of varnish, used as a vehicle. The treads of walkways are painted black with chrome yellow curbs between treads and concrete decks.

Calendar of Coats

The following tabulation gives the calendar of coats on the East Bay superstructure:

Second coat was started on 288-foot spans on January 2, 1935.

Third coat was started on 288-foot spans on March 21, 1935.

Fourth coat was started on 288-foot spans on June 21, 1935.

On July 1, 1935 the status was as follows:

Second coat 288-foot spans 98 per cent complete.

Third coat 288-foot spans 96 per cent complete.

Fourth coat 288-foot spans 4 per cent complete.

Final painting has not begun on 504-foot spans, the cantilever or the Y-B spans.

Drawing of Bridge Superimposed on Photo Taken from Hills East of Oakland

San Francisco Section and Approaches

⟦Contract Nos. 15–15-A⟧

Progress July 1, 1934, to June 30, 1935

General

Contract Nos. 15–15-A, embracing the portions of the San Francisco-Oakland Bay Bridge vehicular structures and approaches in San Francisco, west of the westerly terminus of Contract No. 3, was approved on January 19, 1935. The Healy-Tibbitts Construction Company of San Francisco are the contractors and operations were started on January 23, 1935. Included in this contract are the demolition of the buildings and structures within the limits of the right of way west of Fremont Street, the construction of the reinforced concrete viaducts west of the westerly limits of Contract No. 3, the grading and paving of the streets and all incidental work, except wiring and fixtures for bridge lighting, necessary to complete this unit of the Bridge.

Although awarded as a single unit, the contract is in reality made up of two distinct sections, one of which, Section 15, is financed from the Reconstruction Finance Corporation loan, and the other, Section 15-A, from the State Highway Fund.

Section 15

Section 15, identified in the construction details as the "Main Structure" or "San Francisco Section," extends along a line approximately midway between Harrison and Bryant Streets and from the west limit of Contract No. 3, at a point between Fremont and First Streets, to the easterly limit of the Plaza unit of Section 15-A, a point approximately 270 feet west of Fourth Street. It is comprised entirely of an elevated reinforced concrete viaduct structure. **Elevated Structure**

Section 15-A

Section 15-A, identified as the "Approaches," includes the Fifth Street Plaza unit, the reinforced concrete viaduct structures comprising the "On" and "Off" ramps which connect the city streets and the "Main Structure," in the vicinity of Rincon Hill, and it also includes all of the necessary regrading and paving required to provide the approach to the lower deck of the Bridge.

Demolitions

The location of the construction is in the industrial section of San Francisco. The right of way was occupied by many types of buildings, from frame dwellings to four-story brick and concrete structures, and all are to be demolished under this contract. Out of a total of 216 separate parcels, 206 have been made available, and the buildings have been razed on all of the available parcels except two. This work is well in advance of construction operations. **Buildings Razed**

Utilities Moved

Utility services have not only been discontinued on account of the demolitions, but considerable rerouting has been made necessary to accommodate the bridge construction and approach regrading. This work is being carried out in advance of construction by the city of San Francisco, the Market Street Railway, the Pacific Gas and Electric Company, and the other utilities affected.

Drawing of Approach Vamps, San Francisco

Description of Project

Plaza at Fifth Street

Along the east line of Fifth Street is the Plaza unit, a fill with two graded and paved roadways, one starting at Fifth and Harrison Streets, and the other at Fifth and Bryant Streets, converging at the cellular structure midway between Fourth and Fifth Streets. The cellular structure, which is a part of the Plaza unit, forms the first section of concrete structure and, because of its low elevation, is of a cellular design, composed of six 30-foot spans supported on continuous pile foundations.

From the cellular structure the spans of the main approach are continued on a 3.6 per cent grade to meet the upper deck of the viaduct, now under construction on Contract No. 3. The main approach, a single decked structure, consists of a series of 51 reinforced concrete two-girder spans, varying in length from 50 feet on Rincon Hill to 93 feet at the Second, Third and Fourth Street crossings. The spans are designed as a series of rigid frames with the girders cantilevered over the column bents. The cantilevers in turn support a concrete suspended span which carries the roadway between the frame sections. A roadway width of 58 feet will be maintained throughout the entire length of the main approach.

On Ramp

The entrance to the "On ramp" will be on Fremont Street just south of Harrison Street. From this point a graded roadway, 20 feet wide, continues under the west span of Contract No. 3. Beyond Contract No. 3 the ramp will consist of a reinforced concrete viaduct structure of twenty-one 45-foot spans, and will continue on moderate grades to the main approach.

Off Ramp

The "Off ramp" will leave the main approach at Span 46, in the vicinity of Rincon Street, and continue on easy grades, in a northerly direction, over Harrison and Fremont Streets to the city street level at First Street, midway between Folsom

and Howard Streets. This structure, also of 20-foot roadway width, will be made up of 45-foot reinforced girder spans except at the Harrison and Folsom Street crossings, where the spans will be, respectively, 97 and 88 feet in length.

The construction details specify a heavy cut through Rincon Hill from the lower deck of the double-decked viaduct structure of Contract No. 3. This work necessitates extensive regrading of Harrison Street between First and Second Streets, and of Essex Street between Harrison and Folsom Streets. When completed it will provide for access, on easy grades, to the lower bridge deck from the three of the main traffic arteries, Folsom, Harrison and Second Streets.

Foundation

The rock formation of Rincon Hill, in the area between Folsom, Fremont, Bryant and Second Street, will provide excellent foundation. As the slopes of the hill approach the lower elevations of the surrounding area, the depth to bedrock becomes increasingly great, but a firm foundation of compacted sand is generally expected between Second Street and the midpoint of the block between Third and Fourth Streets. The remainder of the material within the right of way area is of a spongy nature, mainly fills on swampy mud, and concrete foundation piles are being used under the structure. The latter condition holds true for one-fourth of the entire length of the main structure, all of the Plaza unit and the part of the "Off ramp" north of Folsom Street.

Spongy Land

Concrete test piles were driven in the area west of Third Street as soon as practicable after the contract had been awarded. In all, five test piles had been driven to date. From the results of these tests, the lengths of the required foundation piles were determined. Eighteen-inch square piles were cast for lengths over 35 feet and 16-inch square piles for those under 35 feet. To date all piling required for the Plaza and the main structure have been cast and are driven. The pile work for the "Off ramp" has been held up pending the acquisition of the right of way.

Structure

The cellular structure in the Plaza unit is practically completed. Foundation excavations were started on April 5, 1935, and it is expected that the last roadway slabs will be poured shortly.

Foundations have been poured for the main structure through Bent No. 18 and the concrete columns are completed to the ground line to Bent No. 8. Timber falsework piles are being driven for the main approach and driving has progressed to Fourth Street. Piling will be used as falsework centering throughout the entire structure wherever possible.

Timber Falsework Piles

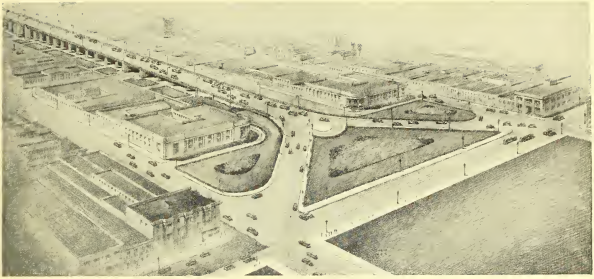
At the "On ramp," excavations for the first ten spans were started shortly after the contract was awarded, rock being uncovered in all cases. The foundations have been poured for the first five spans and columns raised to the girder elevations. Work on this section has been discontinued pending the completion of right of way negotiations.

The work has not started on the "Off ramp" as yet. This construction is of a necessity scheduled for operations after the completion of the Rincon Hill regrade.

Regrading

Regrading is scheduled to start shortly. The excavated material will, as far as practicable, be used in filling the low areas within the limits of the Bridge right of way.

Status of Fifth Street Plaza and Main Bridge Approach, San Francisco, June 30, 1935



Drawing of Fifth Street Plaza, San Francisco Terminus Main Bridge Approach

Equipment

The equipment in use is of the type generally found on work of a similar nature. Piles are handled and driven with a skid driver equipped with a No. 0 Vulcan steam hammer. Material from the foundation excavations is loaded out with a portable crane and a one-yard bucket. The concrete plant erected for Contract No. 3 furnishes concrete for this contract, and covered dump trucks are used to transport the material from the plant to the various units.

Concrete Plant

All concrete is being compacted into the forms by the use of internal vibrators.

A three-quarter yard steam shovel handles the debris from the demolitions and a one and one-quarter diesel power shovel will be used on the regrading.

Summary of Work Completed to Date

Section 15

Demolitions	75 per cent
Excavation—General	8,500 cubic yards
Excavation—Structural	6,350 cubic yards
Concrete piling	16,267 lineal feet
Reinforcing steel placed	390,000 pounds
Concrete poured	3,560 cubic yards
Miscellaneous work	1 per cent
Percentage of project completed	22 per cent

Section 15-A

Demolitions	70 per cent
Excavation—General	None
Excavation—Structural	1,650 cubic yards
Concrete piling	3,978 lineal feet
Reinforcing steel placed	235,000 pounds
Concrete poured	1,450 cubic yards
Miscellaneous work	1 per cent
Percentage of project completed	12 per cent

Expenditures

Section 15

Amount earned by contractor	$150,566 25	
Amount retained	16,659 83	
Amount paid to contractor		$133,906 42
Incidental expenditures		8,135 34
Total expenditures to date		$142,041 76
*Estimated amount for completion		$664,000 00

Section 15-A

Amount earned by contractor	$56,919 60	
Amount retained	6,651 96	
Amount paid to contractor		$50,267 64
Incidental expenditures		4,963 33
Total expenditures to date		$55,230 97
*Estimated amount for completion		$585,000 00

*Exclusive of Survey, Design and Plant Inspection charges.

East Bay Distribution Structure

[State Highway Contract 64TC26-84TC]

Location

This structure is located in Emeryville, Alameda County, at the point where the East Bay approach fill intersects the lines of the Southern Pacific, Key Route, and Santa Fe Railways. At the western end of the structure the Bay Bridge fill lies just north of and adjacent to the Key Route Mole.

The main line of the distribution structure crosses the Southern Pacific and the Key Route just south of the crossing between the railways, which is now effected by a subway on the Key Route under the Southern Pacific tracks. The structure crosses over these tracks and the main easterly line of the structure continued, passes under the important intersection of San Pablo Avenue, Adeline Street, Peralta Street, and Moss Avenue, the latter being the route which Oakland cross-town traffic will take to and from the bridge, and San Pablo Avenue being the down-town route.

Purpose of Structure

The location for the east approach fill along the Key Route Mole and the relation of several of the Key Route lines with the territory to be served by bridge traffic is such that the crossing of certain tracks is unavoidable. The Southern

Pacific and the Santa Fe occupy the Oakland waterfront at this point in such a manner that a crossing over their lines is also unavoidable.

Traffic Problems Solved

The point to which the major east-west traffic is to be delivered is at San Pablo Avenue intersection and lies beyond several local-traffic streets, two of them carrying car lines, which it is undesirable that bridge traffic cross at grade. It is also necessary to provide for the various lines of bridge traffic going to other parts of the East Bay area.

Traffic Problems

The problems may be summarized as follows:

Grade separation of the bridge traffic from the Key Route, Southern Pacific and Santa Fe railways.

Grade separation of the bridge traffic from local streets.

Separation of the various lines of bridge traffic on right- and left-hand roadways.

Dividing bridge traffic into the following lines:

From the bridge to San Pablo Avenue, thence down-town and cross-town, in Oakland and to points south and east.

From the bridge southerly along the Oakland waterfront and toward Alameda.

From the bridge to Berkeley, El Cerrito, Richmond, and points northerly.

Providing for traffic connection other than bridge traffic, as follows:

Cross-town and down-town Oakland to Berkeley, El Cerrito, Richmond, etc.

Oakland waterfront to Berkeley, El Cerrito, Richmond, etc.

The solution of these problems in a single structure resulted in an interlaced and braided bridge of unprecedented complexity. It is difficult even for an engineer to visualize the structure from plans only, and it can be comprehended by a layman only with the aid of a model or photograph of one.

The existence of a network of trolley wires, telephone wires, power lines and gas mains through the site added to the difficulties.

Separations Involved

a. Railway grade separations

Two over the Key Route System, main line.
Two over the Key System yard lines.
Two over the Santa Fe. (One of which is combined with a Key System yard separation.)
Two over the Southern Pacific main line, and interurban lines.

b. Street separations:

Wood Street, which serves the westerly portion of Emeryville.
Louise Street, carrying a Key Route interurban branch.
Hollis Street, carrying a street car line and being a general traffic street through the central industrial portion of Emeryville.

c. Separations of traffic lines within the structure:

CS/MC, Berkeley-Oakland from San Francisco-Berkeley traffic.
NM/MC, San Francisco-Berkeley from Oakland-San Francisco.
CS/NM, Berkeley-Oakland from Oakland-San Francisco.
SB/AN, San Francisco-Oakland (cross-town) from Oakland (waterfront) - San Francisco. (The last coincides with the Oakland-Berkeley line.)

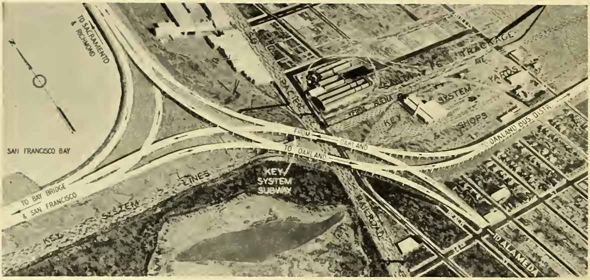


Photo of Model of East Bay Distribution Viaduct

All crossings except those over Louise and Hollis Streets are effected by plate girder steel spans on concrete piers.

There are 11 grade separations within the one structure.

General Description of Structure

The maximum length of any one traffic line on the structure is approximately 3800 feet, with an aggregate length of 8500 feet.

Interlacing Viaduct

The general type of construction consists of 40-foot concrete deck spans supported on concrete piers resting on spread footings. Piers in general have rectangular footings and two supporting columns, with cross-caps and tie-walls. However, the many angles and grades, problems of curvature and variations for special conditions, result in numerous variations from this type, particularly as to the crossings. Nearly 2000 feet of the structure is composed of steel plate girder spans, the details of which present many variations.

Long Steel Girder Spans

The longest steel girder is 148 feet with a span of 118 feet and a cantilever overhang of 28 feet.

The floor system on girder spans is of structural steel with a concrete deck reinforced by welded trusses of the same type used on the main Bay Bridge structure.

The typical concrete spans are of the T-beam type, beams framed into pier caps, with bent reinforcing of the conventional type. Deck slabs vary from 6½ inches to 8 inches.

The roadways will be guarded by concrete curbs carrying 4-inch pipe rail. A lighting and sign system is also provided.

Foundation Conditions

The ground in general consists of clay and clay sands in various stratification, mixed in some cases with gravel, and is quite variable over the area of the structure. Borings indicate that little is to be gained in bearing power below moderate depths. The structure is therefore designed with footings to carry relatively light unit loads, and where suitable material for spread footings at approximately the contemplated depths is not found, piles will be substituted. The contemplated footing depths run from 11 feet below sea level to 19 feet above, according to conditions.

Footings from —11 to +19

Excavation Methods

A majority of the nearly 200 piers, and especially those eastward of the railway tracks, are shallow enough and in material of sufficient stability to be dug as unsupported open holes. The water encountered for the most part is near the top, apparently left from winter rains, and the area drains out rapidly when pumping from piers begins. West of the tracks, the piers are sunk through bay mud into clay, in some cases passing through dredger sand fill for a few feet. Owing to the instability of this material, cofferdams of 2-inch and 3-inch sheeting are used in the deeper piers. The usual method of excavation is to dig a shallow hole large enough to hold the cofferdam frame, set up the frame, set the sheeting completely, then drive with light air driven pile hammers. After this the excavation is made with clamshell buckets operated from cranes on caterpillar treads. The last two or three feet usually necessitate considerable work by hand or with pneumatic clay diggers to excavate the tougher material near the bottom. Cofferdams are pulled and reemployed several times. Cofferdams

In cases where piles are to be used, excavation will be carried only to the permanent water line at about four feet above sea level.

Forms and Falsework

All formwork, except below ground, consists of ⅝-inch 5-ply plywood put together with waterproof glue and capable of being used several times. This type of form produces an almost perfect surface, except for occasional joint lines, without further treatment, and is superior to steel forms in that the sand runs due to imprisoned water, so often found in the latter, do not occur. It is also very adaptable to cutting to any shape and size desirable. Plywood Forms

Over the greater part of the structure, except where steel plate girders are used to support the decks, the forms for decks are carried on steel stringers supported on wood caps which rest on posts carried down to the pier footings. There is thus none of the difficulty involved in the usual method of carrying falsework on temporary surface footings subject to unequal settlement, variable workmanship, tamping, etc.

Placing Concrete

Design of the concrete mixes is carried out by representatives of the Division of Highways Testing Laboratory in cooperation with the San Francisco-Oakland Bay Bridge organization, the latter having direct control of the field placing. Concrete is supplied by the Transit Mix Corporation, Inc., from their plant on Peralta Street, the concrete being mixed en route to the job after being weighed out at the plant. At the site the concrete is discharged into hoppers and buggied, chuted, or hoisted into the forms. Concrete Mixed en route

Electric vibrators are used throughout for compacting the concrete. Curing is done with an impervious oil membrane, a transparent oil being used on all surfaces except the decks, where black oil is used.

Quality of Concrete

In general, the concrete work represents the latest developments in the control of quality and appearance of concrete. Strength averages well over 4000 pounds per square inch, with 5 to 5.4 sacks of cement per yard, and all surfaces, owing to the combination of quality of form work and vibration, strip almost without flaws.

Erection of Steel Spans

The steel plate girder spans vary up to a length of 148 feet. The girders over the Southern Pacific will probably be erected with railroad equipment. Other girders will be placed with caterpillar type revolving cranes. All steel is to be sand blasted and given three coats of paint.

Construction Problems

The project presents unusual difficulties in the field for the following reasons:

Great complexity of lines and grades.

The large number of interlacing public utilities and railroad facilities concerned.

Field Problems

The great length and number of spans of the structure. With almost 200 separate piers and a corresponding number of deck spans, with various appurtenant structures, it is necessary to complete work at the rate of one pier and one span per day through the greater portion of the life of the contract in order to meet contract specifications and to have the structure open for the completion of the Bay Bridge.

This necessitates keeping gangs and equipment at work continually on almost all parts of the project. Work is prosecuted on the basis of two six-hour shifts five days per week. For purposes of administration both the engineering and contracting forces are organized to cover the work in two "sectors," respectively east and west of the Southern Pacific tracks.

In addition, the variable foundation soil, running from mud to a firm gravelly clay, requires close inspection and careful adjustment of footing grades, together with selection of piers where piles are necessary or more economical.

Progress and Status of Work

Work Started May 22, 1935

The contract was awarded to Barrett & Hilp at an estimated cost for contract items of $1,026,780. Work was started on May 22, 1935, and by July 1, 37 footings had been excavated and 10 partially excavated, while 29 footings had been poured and 25 piers concreted to ground lines.

The contractor's personnel includes the following:

J. F. Barrett and H. H. Hilp
I. D. Raffin, Manager and Engineer
George V. McKeever, General Superintendent
J. L. Connelly, Resident Engineer
Martin Valen, Superintendent of East Section
James Lindsay, Superintendent of West Section
L. H. Oliver, Field Office Manager

East Bay Approaches

⟦Division of Highways Contracts Nos. 64TC16, 84TC1–64TC26 and 64TC29; and Bridge Contract Nos. 20 and 20-A⟧

The East Bay approaches to the San Francisco-Oakland Bay Bridge involve the following contracts:

64TC6 [No. 20], The American Dredging Company, $869,063.32, for the construction of the dredger fill from the Key Mole east to Emeryville and thence northerly to Berkeley; and

64TC8 [No. 20-A], Fredrickson & Watson Construction Co., and Fredrickson Brothers, $274,687.50, for the rock retaining wall for Contract No. 20; and

64TC16, Healy-Tibbitts Construction Company, $26,433.50, for subway beneath the fill opposite Emeryville.

84TC1–64TC26, Barrett & Hilp, $1,026,780, for the East Bay interlacing distribution viaducts at Emeryville.

64TC29, J. F. Knapp, $117,478, for the construction of a concrete subway under the Southern Pacific tracks at Folger Avenue, Berkeley.

(In the first Annual Report the first three contracts mentioned above were described in detail.)

During the past year, the approach construction work has progressed at a rapid pace, with projects under way on both sides of the Bay.

The dredger fill, which was described at considerable length in the previous report, was completed on December 28, 1934, with a total of 3,823,728 cubic yards having been pumped.

Considerable attention was given to subsidence studies, to determine the rate of settlement, especially along the mole line, where firm material was at varying depths, in some cases being quite deep. The settlement rates were plotted on charts, showing the rates with each stage of fill placed. Each additional stage increased the rate of settlement, due to the added load.

From these studies it was possible to compute the future rate of settlement, and estimate the additional height necessary to provide sufficient material, so that when the completed project reached a state of equilibrium with the major subsidence complete, the top of the fill would be approximately to the ultimate grade. In some locations, where the underlying soft material was quite deep, the fill was placed as much as eight feet above the ultimate grade. Settlement records taken after completion of the project until the present time, have confirmed the studies made, and the results have checked the computations very closely.

The Rock Wall contract was completed on April 5, 1935, and the final quantity of rock placed amounted to 101,750 tons of core rock, and 95,403 tons of face rock. This work was prosecuted in an orderly fashion, and was completed well ahead of the contract limit.

The access subway for the Paraffine Companies, under contract to Healy-Tibbitts Construction Company, will be finished within the next month, being at the present time about 95 per cent complete.

On May 22, 1935, Barret and Hilp commenced work on the Distribution Structure, which crosses the tracks of the Key System, Southern Pacific, and Santa Fe Railways at the east end of the mole.

Extension of Sand Fill for Berkeley Traffic Facing Berkeley

This interlacing structure, which contains 1.6 miles of roadway, also affects sixteen grade separations. All travel on the Distribution Structure will be unidirectional, or one-way traffic, which minimizes the driving hazards.

On June 8, 1935, J. F. Knapp commenced work on the Folger Avenue Subway. This structure crosses under the tracks of the Southern Pacific Company at Folger Avenue in the city of Berkeley, providing a 44-foot width of pavement.

Falsewook is being installed for supporting the railroad tracks during construction, and excavation for the structure will soon commence.

Plans for the central branch of the East Bay Approaches are under way, and the San Pablo Avenue undergrade crossing will soon be advertised for bids. As soon as possible thereafter, the plans for the south branch will be completed and that project advertised for contract.

In addition to the approaches to the bridge, which are financed by the $6,600,000 appropriated for that purpose by the State Legislature, the Division of Highways is building a system of extensions, which includes Harrison, Bryant, Tenth and Potrero Streets in San Francisco, and Moss Avenue and the East Shore Highway in Alameda County. These improvements are financed from regular gas tax funds allocated to the projects.

Bridge Railway

The San Francisco-Oakland Bay Bridge will provide facilities for the transportation of more than 30,000,000 train passengers annually, a large part of whom will be commuters, numbering about 50,000, who live in Alameda County and now go to San Francisco by the combination East Bay electric railways and ferryboats. In the future the transportation will be by the same East Bay electric lines, which, however, are to be extended over the bridge to a terminal in San Francisco. The bridge was designed as much for this great mass of commuting traffic as for the motorist traffic.

The Citizens' Financial Advisory Committee to the California Toll Bridge Authority, a committee of representative citizens of the cities around the Bay region, recommended to the Toll Bridge Authority that the authority provide for an electric railway over the bridge on the same self-liquidating basis upon which the bridge proper is being constructed, and that the California Toll Bridge Authority should acquire statutory power to own, operate and lease cars, trains and other equipment over and in connection with the bridge; and, further, that the existing East Bay lines be given leases on the Authority's railway over the bridge so that the present East Bay cars might, instead of terminating at the ferry slips on the east shore, cross the bridge to a terminal in San Francisco and return.

It was recommended that contracts be drawn between the California Toll Bridge Authority and the Key System and Southern Pacific Companies, owners of the East Bay lines, at a toll sufficient to pay interest on and progressively amortize the capital investment.

Several sites for the terminal in San Francisco were proposed and were given thorough engineering analyses. Considerations in the location of the terminal were: passenger comfort and convenience, capital investment, proximity to the destinations of the commuters, traffic congestion, damage to adjoining property,

suitable foundations, grades, street clearances for overheads, et cetera. The site recommended is Plan "X," involving a terminal between First and Fremont Streets, just south of Mission.

Innumerable civic organizations entered into conferences with the engineers and the Toll Bridge Authority with many suggestions for locations of terminals. Beginning with September 6, 1934, almost constant conferences and correspondence have been in progress on the bridge railway and its terminal. The Reconstruction Finance Corporation joined in the study of the entire interurban problem in October, 1934, when the board requested Chief Engineer Morton Macartney and Robert J. Cummins, Special Advisory Engineer of the Reconstruction Finance Corporation, to consider the problem of mass transportation between Alameda and San Francisco counties. Mr. Cummins made a survey of the project on location.

Negotiations between the railroads involved and the California Toll Bridge Authority upon the proposed contracts were undertaken under the direction of the Financial Advisory Committee and attorneys for the Toll Bridge Authority.

On November 16, 1934, the Key System and the Southern Pacific Company filed applications with the State Railroad Commission for certificates of public convenience and necessity to operate electric trains over the bridge and the right of abandonment of existing ferries. Hearings on the terminals and forms of contracts between the California Toll Bridge Authority and the railroads were held by the State Railroad Commission, with the city attorneys of all the communities around the Bay region participating.

In the meantime, on November 30, 1934, the Financial Advisory Committee recommended that the Toll Bridge Authority give favorable consideration to the railway contracts along the general lines submitted, so that application might be made to the Reconstruction Finance Corporation for an increase of existing loan on the basis of the contracts.

On December 18, 1934, the Reconstruction Finance Corporation, through its Board of Directors, adopted a resolution providing for the increase of the existing loan of $61,400,000 to $71,400,000 to provide for the construction of the bridge railway and terminal and equipment; and requiring that the railroad companies operating East Bay lines and ferries shall have abandoned ferryboat competition to the bridge electric railway before the loan be forthcoming. Inasmuch as engineers' estimates indicated that at least $5,000,000 would be saved out of the first authorization of $61,400,000 from the Reconstruction Finance Corporation, the State therefore had available, with this increase of ten million dollars, the total sum of $15,000,000, which the Chief Engineer had estimated to be the cost of the bridge railway. Changes in the California Toll Bridge Authority Act, to enable the Authority to build a railway, were also required by the Reconstruction Finance Corporation; and these changes were effected by the State Legislature that met in January, 1935.

The California Toll Bridge Authority met on January 3, 1935, in a public hearing in the Assembly Chamber of the State Capitol, Sacramento, at which Governor Frank F. Merriam, as chairman, declared the policy that the State would not enter into any contract with the railroad companies that was not favorably regarded by the cities affected by the bridge railway. The municipal authorities involved named their city attorneys to confer with the attorneys for the California Toll Bridge Authority, and by the close of the fiscal year, July 1, 1935, all the

principal provisions of the contracts between the California Toll Bridge Authority and the railroad companies were outlined in conference; submitted to the railroad companies; and agreed upon by all.

At the close of this year of legal and civic negotiations it was for the first time possible to begin looking toward engineering designs of the bridge railway with such an important factor as the location of the terminal practically, although as yet unofficially, fixed.

The main tenets of the contracts, which arose from the conferences with the attorneys for the cities, provided that passenger fares over the bridge railway would remain at the existing ferry level for the first eighteen months of operation; and that the contracts with the railroads provide the right to the State to terminate the contracts in favor of public operation at the expiration of any five-year period on two years' notice.

During the last six months of the fiscal year ending June 3, 1935, engineering was at a standstill on the railroad design, awaiting results of negotiations. With the practical acceptance of Plan "X," the location of the terminal between Beale and Second Streets, fronting on Mission, and all the reqirements of connection to future subways, existing street car systems, and proximity to business centers were met. Fronting on Mission, between Beale and Second Streets, engineers proposed to construct a three-story and basement structure, 164 feet by 700 feet in plan. It was upon these preliminary plans, submitted in a tentative form due to continuance of site conferences, that the Reconstruction Finance Corporation, in December, 1934, adopted a resolution to increase the loan to the California Toll Bridge Authority in order to build the bridge railway and terminal.

STATUS OF RIGHT OF WAY DEEDS ON JULY 1, 1935

	LINE	Total Number of Deeds	Deeds Executed			
			No.	COST (Not including title reports, insurance, engineering, contingencies, etc.)		
				Land	Imprs., etc.	Total
Bridge	Original Line	60	57	$750,526.45	$522,511.55	$1,273,038.00
	Stillman St. Change	47	44	388,667.00	339,810.91	728,477.91
	Total	107	101	1,139,193.45	862,322.46	2,001,515.91
S. F. Bridge Approaches	5th St. Approach	11	11	222,193.75	174,890.14	397,083.89
	"On" Ramp	8	7	98,607.50	26,315.00	124,922.50
	"Off" Ramp	34	26	139,323.30	206,689.26	346,012.56
	Account of Regrade	18	6	17,850.00	33,808.53	51,658.53
	Total	71	50	477,974.55	441,702.93	919,677.48
Alameda Bridge Approaches	Cypress St.	89	50	127,630.72	45,492.15	173,122.87
	38th St.	90	71	165,349.84	112,653.46	278,003.30
	Ashby Ave.	43	23	77,586.40	20,269.91	97,856.31
	Total	222	144	370,566.96	178,415.52	548,982.48
	Grand Totals	400	295	$1,987,734.96	$1,482,440.91	$3,470,175.87

CONTRACT PAYMENTS AS OF JUNE 30, 1935

Completed to Date			Total	To Complete	Total of Contracts
No.	Contract	E.W.O.			
2	$7,398,623	$76,136	$7,474,759		$7,474,759
3	751,606	15,840	767,446	$335,914	1,103,360
4	4,475,815	104,375	4,580,190		4,580,190
5	1,396,836	338,764	1,735,600	659,750	2,395,350
6	3,634,134	2,681	3,636,815	10,392,185	14,029,000
7	5,372,289	42,249	5,414,538	3,543,462	8,958,000
8	255,770	7,401	263,171		263,171
9	78,887	1,559	80,446	760,874	841,320
15	148,462	100	148,562	575,119	723,681
Total	$23,512,422	$589,105	$24,101,527	$16,267,304	$40,368,831

Original Contracts as Let		$38,625,154
Provided for Contingencies	$1,743,677	
Other Work Through Contingencies	510,000	2,253,677
Estimated Total of Contracts as Above		$40,878,831

ESTIMATED COST OF CONTRACTS TO BE LET

Contract No.		
10	Administration Building	$361,132.00
11	Electrical Contract	353,542.00
12	Traffic Signs	300,000.00
13	Tunnel Lining	60,000.00
16	Operating Equipment	30,000.00
	Superstructure, Harbor Pier 24	50,000.00
	Total	$1,154,674.00

SAN FRANCISCO-OAKLAND BAY BRIDGE

CONSOLIDATED STATEMENT OF RECEIPTS AND EXPENDITURES

FROM SEPTEMBER 14, 1932, TO JUNE 30, 1935

RECEIPTS			
Bonds sold to R.F.C.			
June 12, 1933	$2,000,000.00		
Sept. 8, 1933	2,000,000.00		
Nov. 21, 1933	2,000,000.00		
Jan. 20, 1934	3,000,000.00		
Mar. 19, 1934	3,000,000.00		
June 5, 1934	3,000,000.00		
Aug. 22, 1934	4,000,000.00		
Nov. 9, 1934	3,000,000.00		
Dec. 27, 1934	3,000,000.00		
Mar. 25, 1935	3,000,000.00		
June 5, 1935	3,000,000.00		$31,000,000.00
Transfer From State Chapter 400			10,803.39
Interest from Banks			35,588.50
Rents from Property Acquired			4,785.87
Accrued Interest			46,467.39
			$31,097,645.15
EXPENDITURES			
Engineering Design		$324,763.99	
Triangulation and Survey		163,337.48	
Launch Operations, including cost of Boats and Radio Phones		91,521.90	
Administration including S. F. Office Rent, 'Phone, Clerical and Accounting Staff, Progress and Traffic Studies		244,526.86	$824,150.23
Consulting Engineers and Consulting Architects			322,907.77
Insurance			414,922.72
Legal			92,840.53
Property, Right of Way, S. F. Approach			2,064,736.30
Rental of Pier 24			52,083.25
Moving Cables—West Bay			92,670.47
Inspection of Steel, Concrete and Materials, all Contracts			240,406.61
Contract 2—Substructure—West Bay Crossing			
Contract Pay Estimates		$7,474,759.14	
Engr. Supervision and Expense		105,627.83	
Diving Operations		18,475.85	7,598,862.82
Contract 3—S. F. Anchorage			
Contract Pay Estimates		690,721.47	
Engr. Supervision and Expense		43,311.34	734,032.81
Contract 4—Substructure East Bay Crossing			
Contract Pay Estimates		4,580,189.88	
Engr. Supervision and Expense		67,517.51	
Diving Operations		22,706.29	4,670,413.68
Contract 5 —Yerba Buena Island Crossing			
Contract Pay Estimates		1,565,288.36	
Engr. Supervision and Expense		71,902.66	1,637,191.02
Contract 6—Superstructure West Bay Crossing		3,277,663.85	
Engr. Supervision and Expense		53,455.50	3,331,119.35
Contract 7—Superstructure East Bay Crossing			
Contract Pay Estimates		4,873,916.98	
Engr. Supervision and Expense		71,020.53	4,944,937.51
Contract 8—Girder Spans on Mole			
Contract Pay Estimates		263,170.95	
Engr. Supervision and Expense		35,892.04	
Diving Operations		231.65	299,294.64
Contract 9—Final Field Painting Contract Pay Estimate		72,401.47	
Engr. Supervision and Expense		5,453.41	77,854.88
Contract 10—Administration Bldg.			
Engr. Supervision and Expense			11,188.03
Contract 11—Electric Contract. Engr. Superv.			10,703.64
Contract 15—S. F. Section—Cont. Pay Estimates		133,906.42	
Engr. Supervision and Expense		8,135.34	142,041.76
Interest and Discount on Bonds			2,004,181.25
Coupon Deposit for Interest			607,500.00
			$30,174,039.27
Balance with State Treasurer			923,605.88
			$31,097,645.15

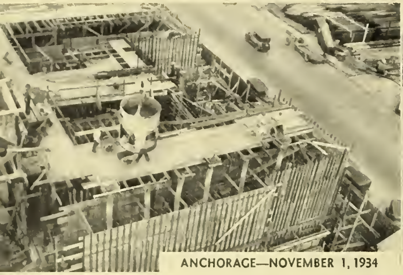
PICTORIAL PROGRESS

OF

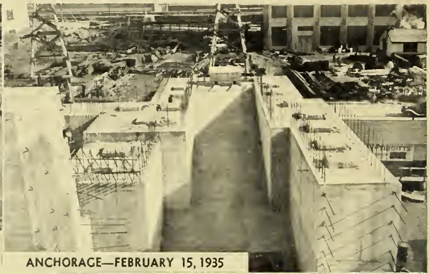
SAN FRANCISCO-OAKLAND BAY BRIDGE

PAGES 64 TO 79 INCLUSIVE

SAN FRANCISCO ANCHORAGE



ANCHORAGE—NOVEMBER 1, 1934



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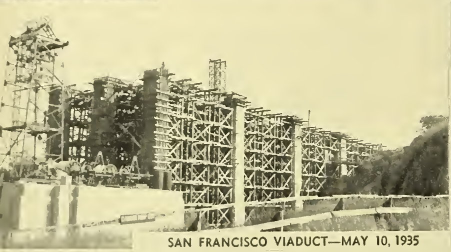
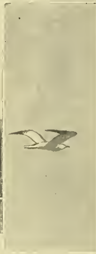
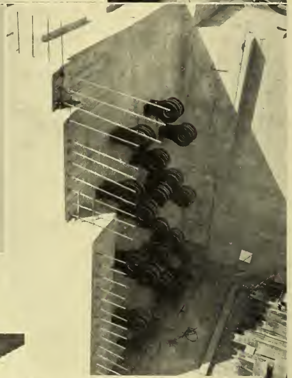


SAN FRANCISCO VIADUCT—MAY 10, 1935





SAN FRANCISCO ANCHORAGE—OCTOBER 19, 1934

CENTER ANCHORAGE

NORTH "A" FRAME—APRIL 22, 1935

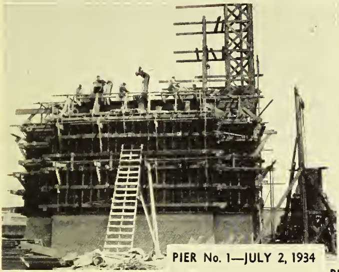
"A" FRAME—JACKS PRESTRESSING EYEBARS

ANCHORAGE GIRDERS, PIER 4—MARCH 21, 1935

"A" FRAME EYEBARS—MARCH 21, 1935

CENTER ANCHORAGE—APRIL 17, 1935

PIER W-1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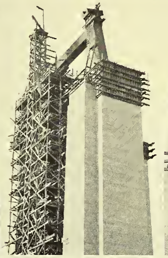
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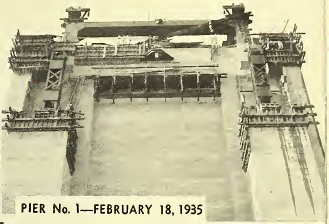
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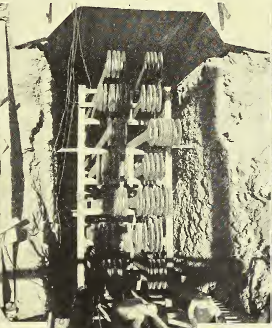
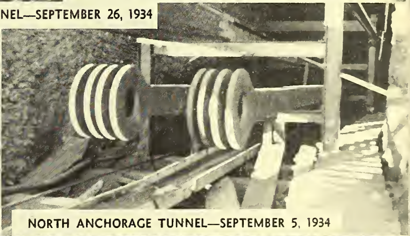
YERBA BUENA ANCHORAGE TUNNELS


SOUTH ANCHORAGE TUNNEL——JULY 27, 1934


NORTH ANCHORAGE TUNNEL—SEPTEMBER 26, 1934


SOUTH ANCHORAGE TUNNEL—OCTOBER 23, 1934


NORTH & SOUTH ANCHOR TUNNELS—AUG. 22, 1934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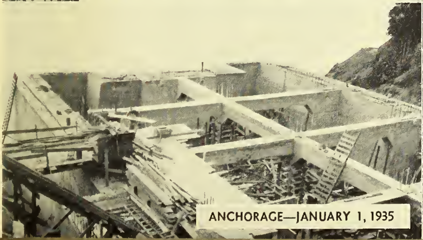
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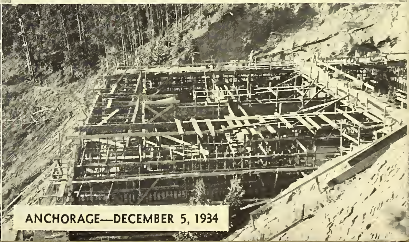

ANCHORAGE—DECEMBER 5, 1934

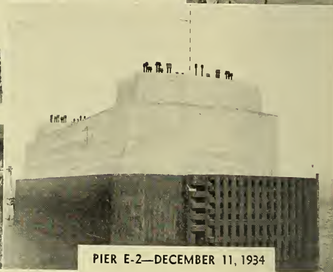
EAST BAY COFFERDAMS

PIER E-9—JULY 7, 1934

PIER E-2—OCTOBER 17, 1934

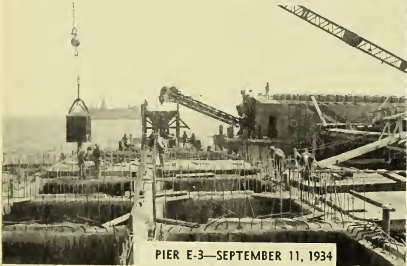
PIER E-2—NOVEMBER 2, 1934

PIER E-2—SEPTEMBER 11, 1934



PIER E-2—DECEMBER 11, 1934

EAST BAY PIER E-3



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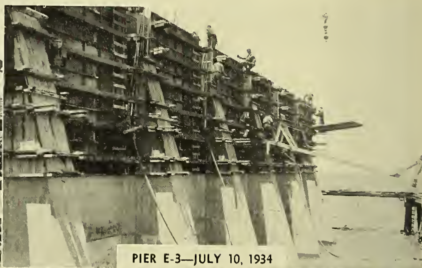

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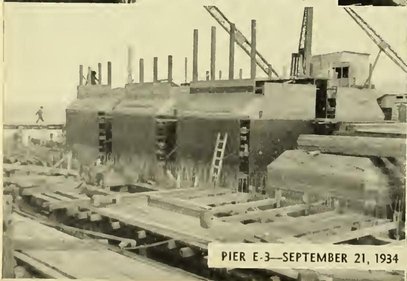

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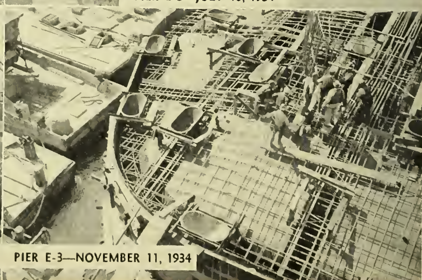
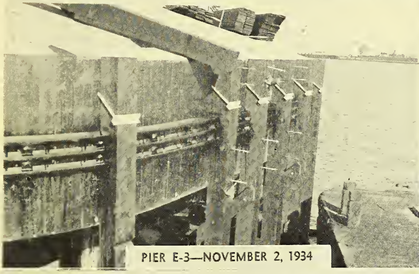


PIER E-3—NOVEMBER 11, 1934

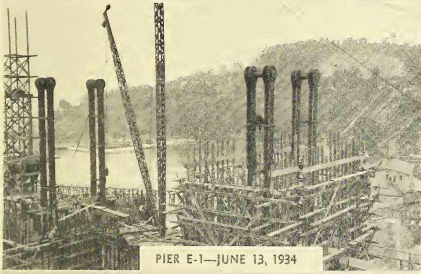
EAST BAY PIER E-3



PIER E-3—NOVEMBER 2, 1934

PIER E-3—NOVEMBER 23, 1934

CANTILEVER ANCHOR PIER E-1



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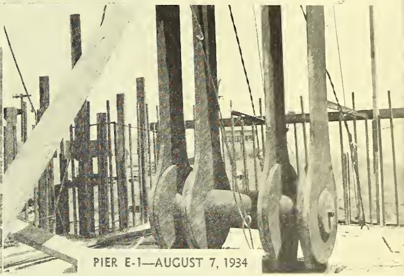
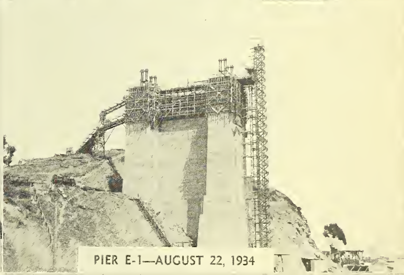


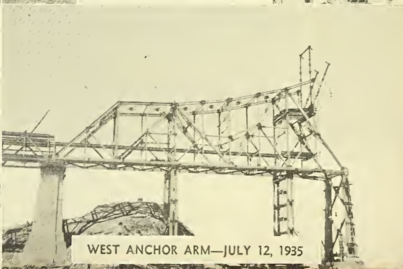
PIER E-1—AUGUST 7, 1934

PIER E-1—AUGUST 7, 1934



PIER E-1—AUGUST 22, 1934

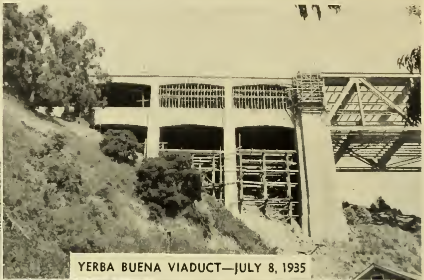
EYEBAR SHOE—PIER E-1—MARCH 19, 1935



WEST ANCHOR ARM—JULY 12, 1935

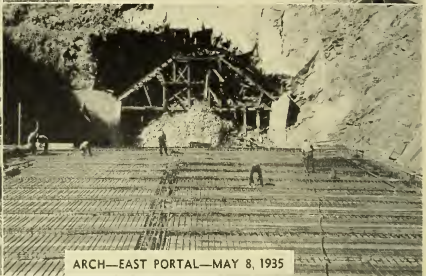
YERBA BUENA ISLAND VIADUCT

PIER Y. B.-1—JULY 7, 1934



YERBA BUENA VIADUCT—JULY 8, 1935

EAST APPROACH—FEBRUARY 5, 1935



ARCH—EAST PORTAL—MAY 8, 1935

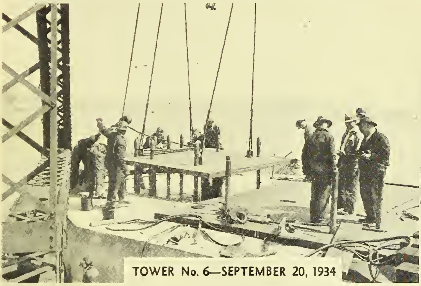
STATION STAIRWAY—MARCH 8, 1935

YERBA BUENA VIADUCT—JULY 12, 1935

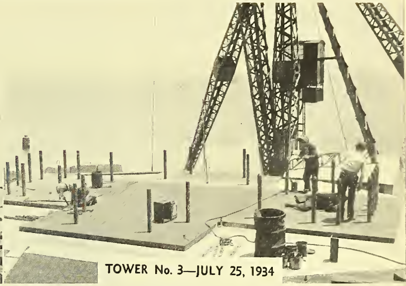
UNDERPASS—MARCH 8, 1935

YERBA BUENA VIADUCT—JULY 12, 1935

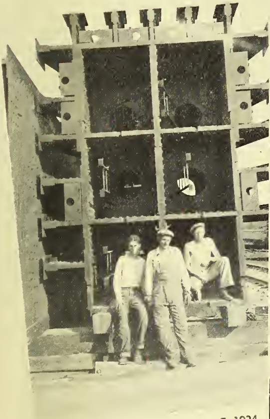
SUSPENSION TOWER ERECTION



TOWER No. 6—SEPTEMBER 20, 1934



TOWER No. 3—JULY 25, 1934



TOWER No. 5—NOVEMBER 5, 1934

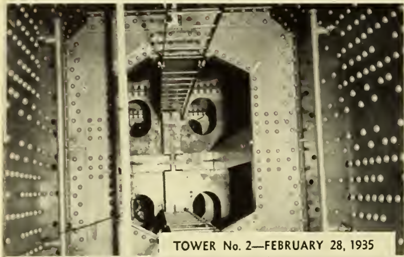
TOWER No. 3—AUGUST 13, 1934

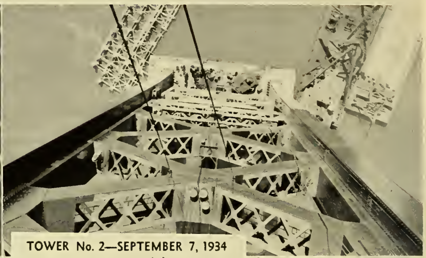
TOWER No. 5—FEBRUARY 26, 1935

TOWER No. 6—SEPTEMBER 27, 1934

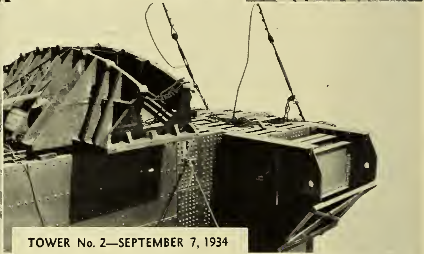
TOWER No. 5—JANUARY 29, 1935

SUSPENSION TOWER ERECTION


TOWER No. 2—FEBRUARY 28, 1935


TOWER No. 2—SEPTEMBER 7, 1934


TOWER No. 2—SEPTEMBER 7, 1934


TOWER No. 2—SEPTEMBER 7, 1934


TOWER No. 2—SEPTEMBER 7, 1934


TOWER No. 2—SEPTEMBER 25, 1934


CABLE BENT POST—DECEMBER 5, 1934

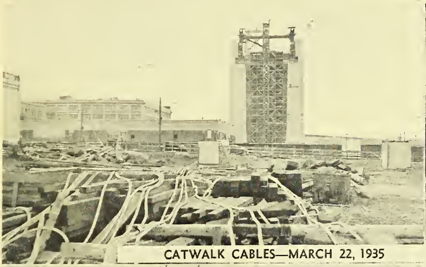
CABLE BENT

PIER W-1

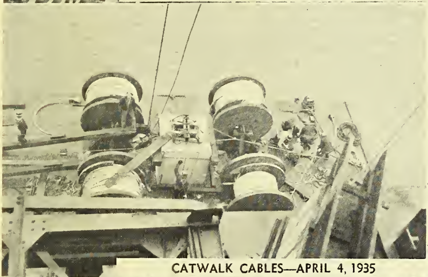
SAN FRANCISCO

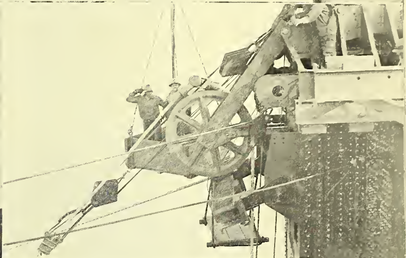

CABLE BENT—DECEMBER 17, 1934

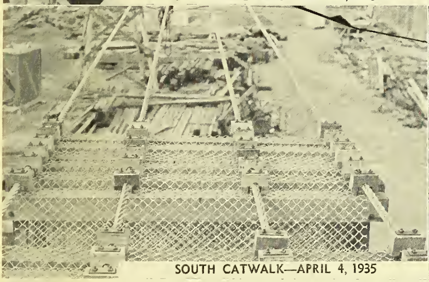
CATWALK ERECTION


CATWALK CABLES—MARCH 22, 1935


CATWALK CABLE—APRIL 4, 1935


CATWALK CABLES—APRIL 4, 1935

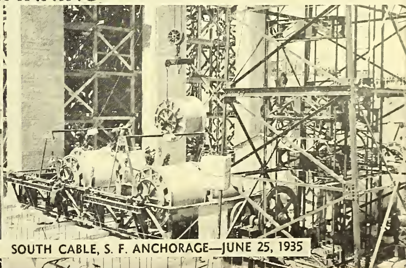

NORTH CATWALK—MAY 1, 1935


SOUTH CATWALK—APRIL 4, 1935


SOUTH CATWALK—MAY 5, 1935

CABLE SPINNING

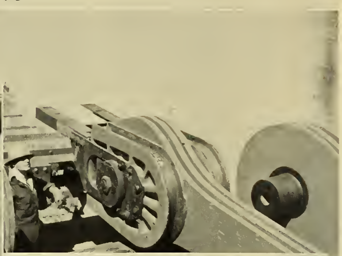

SAN FRANCISCO ANCHORAGE—JUNE 24, 1935


SOUTH CABLE, S. F. ANCHORAGE—JUNE 25, 1935

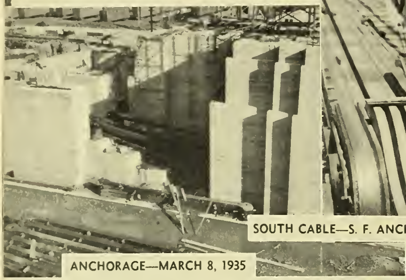
CABLE SPINNING

SOUTH CATWALK—SPAN W1-W2—JUNE 17, 1935

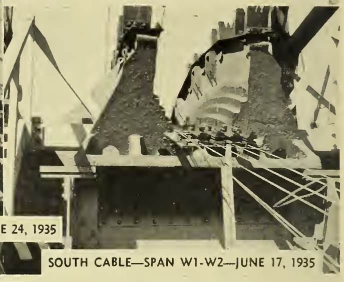
SOUTH CABLE—S. F. ANCHORAGE—JUNE 24, 1935



N. CABLE STRAND SHOES—S. F. ANCHORAGE, 5-27-35



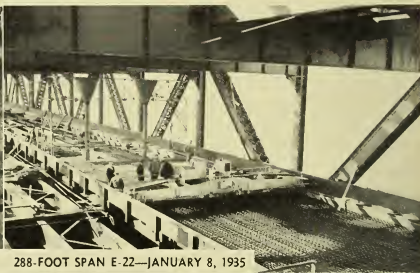
ANCHORAGE—MARCH 8, 1935



SOUTH CABLE—SPAN W1-W2—JUNE 17, 1935

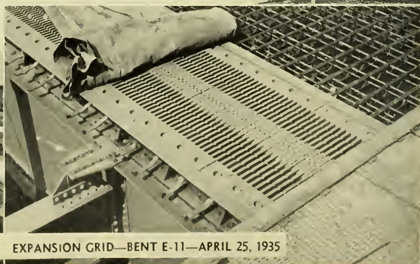
PAVING

288-FOOT SPAN E-22—JANUARY 8, 1935



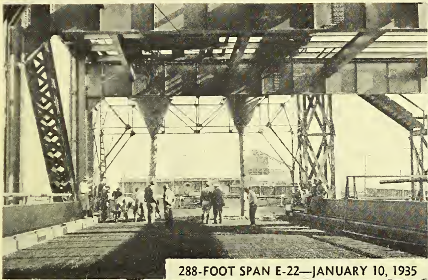
288-FOOT SPAN E-22—JANUARY 8, 1935

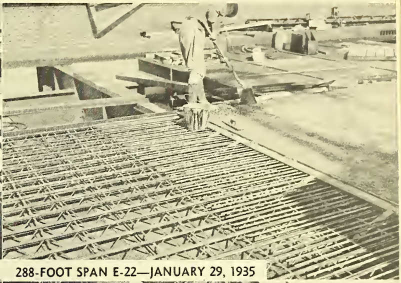
288-FOOT SPAN E-22—JANUARY 21, 1935

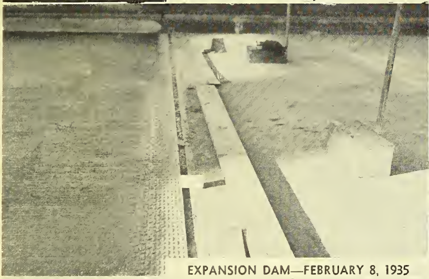


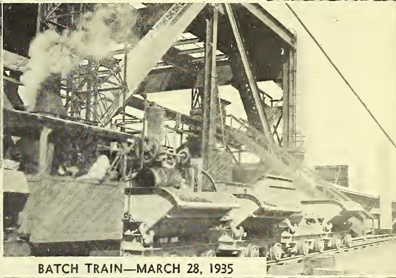
EXPANSION GRID—BENT E-11—APRIL 25, 1935

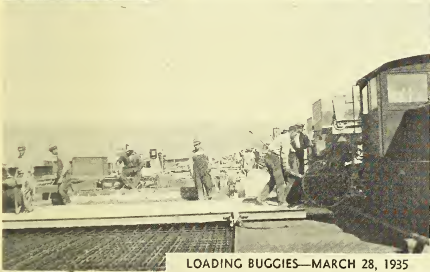
PAVING


288-FOOT SPAN E-22—JANUARY 10, 1935

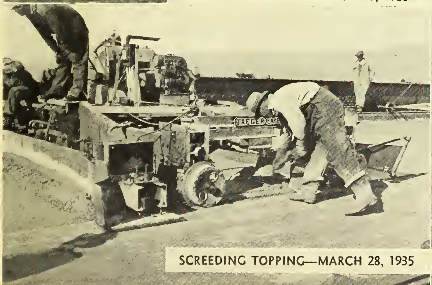

288-FOOT SPAN E-22—JANUARY 29, 1935


EXPANSION DAM—FEBRUARY 8, 1935


BATCH TRAIN—MARCH 28, 1935


LOADING BUGGIES—MARCH 28, 1935


HAMMERING TILE—MARCH 28, 1935

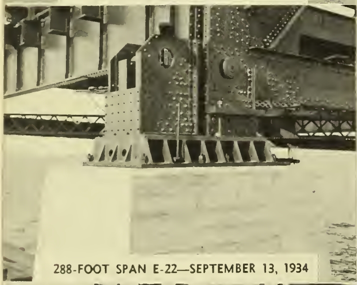

SCREEDING TOPPING—MARCH 28, 1935


288-FOOT SPANS—APRIL 19, 1935

EAST BAY SUPERSTRUCTURE

STEEL PONTOONS—AUGUST 10, 1934

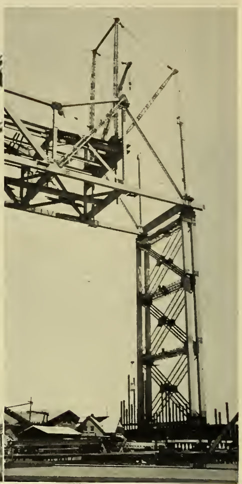
288-FOOT SPAN E-22—AUGUST 15, 1934



288-FOOT SPAN E-22—SEPTEMBER 13, 1934

FALSEWORK COLUMN SHOE—MARCH 19, 1935

SPLIT TOWER (EXPANSION)
FEBRUARY 18, 1935



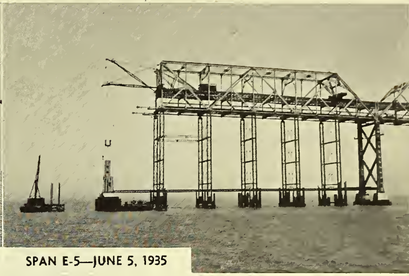
WEST ANCHOR ARM
JUNE 5, 1935

WEST ANCHOR ARM
JUNE 5, 1935

SPAN E-5
JUNE 7, 1935

EAST BAY SUPERSTRUCTURE

SPAN E-7—APRIL 19, 1935



SPAN E-5—JUNE 5, 1935

TUNNEL

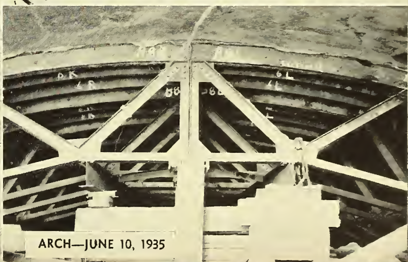
PILOT TUNNEL No. 1—JULY 3, 1934

PILOT TUNNELS No. 1, No. 2, No. 3—AUGUST 7, 1934

TUNNEL SIDEWALLS—MARCH 20, 1935

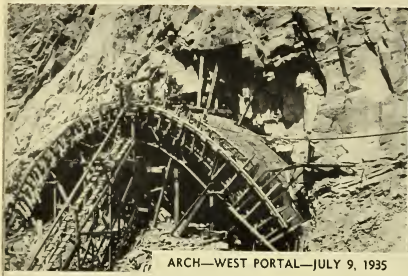
ARCH—MARCH 27, 1935

ARCH—EAST PORTAL—MAY 21, 1935



ARCH—JUNE 10, 1935

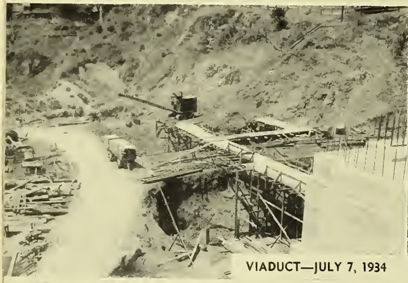
TUNNEL



ARCH—WEST PORTAL—JULY 9, 1935

TUNNEL—EAST PORTAL—JULY 12, 1935

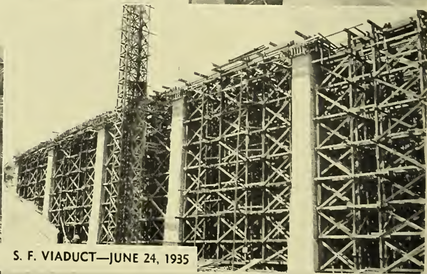
SAN FRANCISCO VIADUCT



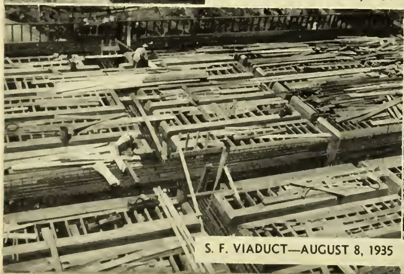
VIADUCT—JULY 7, 1934

VIADUCT—AUGUST 9, 1934

VIADUCT—NOVEMBER 1, 1934



S. F. VIADUCT—JUNE 24, 1935



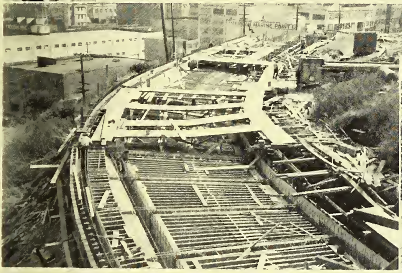
S. F. VIADUCT—AUGUST 8, 1935

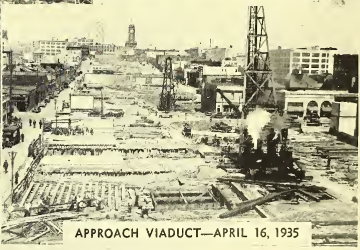
S. F. VIADUCT—AUGUST 22, 1935

SAN FRANCISCO APPROACHES

BENT No. 22—APPROACH VIADUCT—JULY 12, 1935


BENT No. 5—VIADUCT—MAY 31, 1935

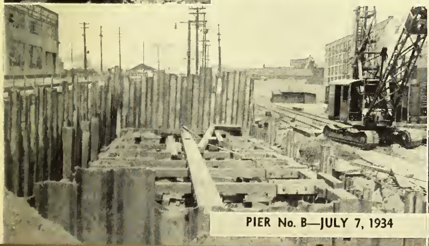

"ON RAMP"—BENTS No. 121-No. 116—JULY 16, 1935


APPROACH VIADUCT—APRIL 16, 1935

SAN FRANCISCO VIADUCT

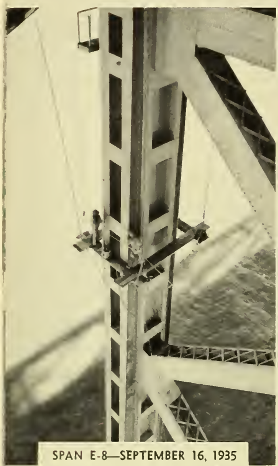

PIER No. B—OCTOBER 11, 1934


PIER No. A—NOVEMBER 9, 1934


PIER No. B—JULY 7, 1934


PIER No. B—NOVEMBER 30, 1934

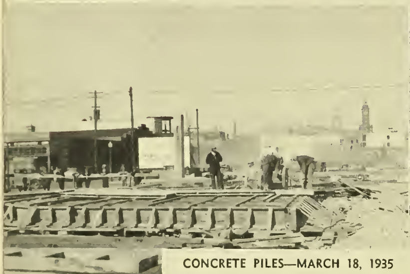
BRIDGE PAINTING-APPLICATION OF ALUMINUM



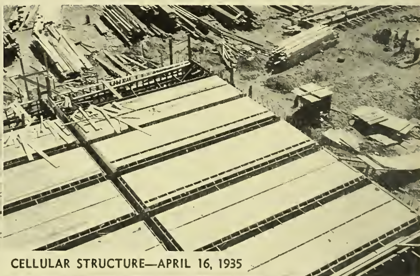
SPAN E-8—SEPTEMBER 16, 1935

TOWER No. 2—MARCH 15, 1935

SAN FRANCISCO APPROACHES
CONCRETE GIRDER SPANS AND CELLULAR VIADUCT



CONCRETE PILES—MARCH 18, 1935

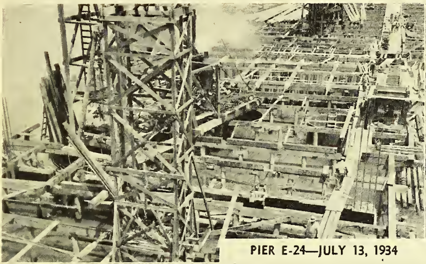


CELLULAR STRUCTURE—APRIL 16, 1935

BENT No. 1—VIADUCT—APRIL 16, 1935

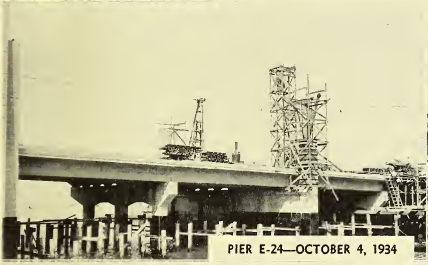
NORTH FOOTING—BENT No. 1—MAY 1, 1935

LOWER DECK AT MOLE

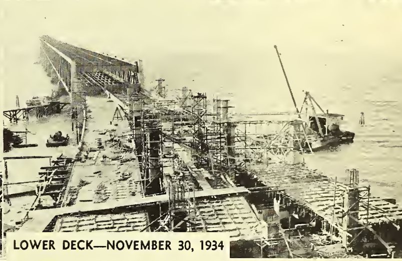


PIER E-24—JULY 13, 1934

PIER E-25A—SEPTEMBER 6, 1934

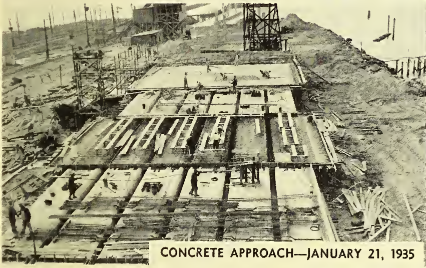


PIER E-24—OCTOBER 4, 1934

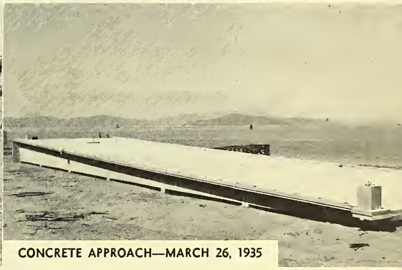


LOWER DECK—NOVEMBER 30, 1934

UPPER DECK AT MOLE

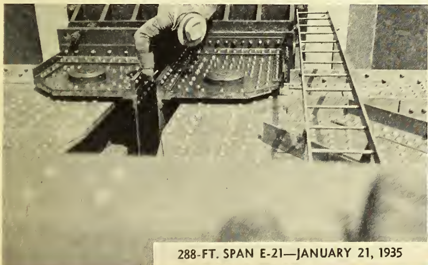


CONCRETE APPROACH—JANUARY 21, 1935



CONCRETE APPROACH—MARCH 26, 1935

BRIDGE PAINTING



288-FT. SPAN E-21—JANUARY 21, 1935

SPAN E-7—AUGUST 30, 1935

INDEX TO ILLUSTRATIONS

PICTORIAL PROGRESS OF SAN FRANCISCO-OAKLAND BAY BRIDGE

APPENDICES
A to H

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
· SAN · FRANCISCO-OAKLAND · BAY · BRIDGE

FINAL · FIELD · PAINTING
· CONTRACT NO. 9 ·

Bids Opened
2:00 P.M. November 7, 1934
Room 811, 500 Sansome St., S.F.

TABULATION OF BIDS

ITEM	QUANTITIES	UNIT	DESCRIPTION
1	24,000	TONS	STEEL IN TOWERS TO BE PAINTED (WEST BAY CROSSING)
2			CABLES AND ACCESSORIES TO BE PAINTED · LUMP SUM ·
3	39,000	TONS	STEEL IN SPANS TO BE PAINTED (WEST BAY CROSSING)
4	58,000	TONS	STEEL IN SPANS TO BE PAINTED (EAST BAY CROSSING)

	BRIDGE BUILDERS INC. 155 SANSOME ST. SAN FRANCISCO.		R. P. PAOLI. 3159 FILLMORE ST. SAN FRANCISCO.		AM. BLDG. MAINT. CO. 467 O'FARRELL ST. SAN FRANCISCO.		D. ZELINSKY & SONS, INC. 165 GROVE ST. SAN FRANCISCO.	
BIDDER'S BOND / CERTIFIED CHECK		$100,000.00		$100,000.00		$150,000.00		$120,000.00
ITEM	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	4.50	108,000.00	3.44	82,560.00	3.80	91,200.00	4.90	117,600.00
2		180,000.00		82,220.00		316,000.00	----	335,300.00
3	5.40	210,600.00	7.78	303,420.00	5.91	230,490.00	6.86	267,540.00
4	5.80	336,400.00	7.10	411,800.00	5.76	334,080.00	6.97	404,260.00
TOTALS		$835,000.00		$880,000.00		$971,770.00		$1,124,700.00

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

SAN FRANCISCO-OAKLAND BAY BRIDGE

FINAL FIELD PAINTING
CONTRACT NO 9

Bids Opened
2:00 PM November 7 1934
Room 311 [illegible] S.F.

ITEM	QUANTITIES	UNIT	DESCRIPTION
1	24000	TONS	STEEL IN TOWERS TO BE PAINTED [illegible]
2			CABLES AND ACCESSORIES TO BE PAINTED [illegible]
3	39000	TONS	STEEL IN SPANS TO BE PAINTED [illegible]
4	58000	TONS	STEEL IN SPANS TO BE PAINTED [illegible]
TOTALS			

STATE OF CALIFORNIA
SAN FRANCISCO-OAKLAND BAY BRIDGE
ELECTRICAL WORK
CONTRACT NO.11 AND NO 11A

Bids Opened
June 26 1935 2:00 P.M.
Room 811 500 Sansome St S.F.

TABULATION OF BIDS

				ALTA ELECTRIC & MECH CO INC. AND AMER BLDG. MAIN COMPANY, 467 O'FARRELL, SAN FRANCISCO		N^C PAGE M^CKENNY & KENNY BROS, 7 FRONT STREET, SAN FRANCISCO		RADELFINGER BROS., 544 NATOMA ST, SAN FRANCISCO		CLINTON CONST COMPANY, 924 FOLSOM ST, SAN FRANCISCO	
		Bidder's Bond / Certified Check		Bidder's Bond $60000.00		Certified Check $55000.00		$57000.00		$65000.00	
ITEM	QUANT	DESCRIPTION		UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
		CONTRACT NO 11 BRIDGE									
1		Supply Stations	Lump Sum		5137.00		6790.00		6465.00		7000.00
2		Substation No 1	Lump Sum		6213.00		7615.00		8182.00		8300.00
3		Substation No. 2	Lump Sum		3714.00		5077.00		5434.00		5700.00
4		Substation No 3	Lump Sum		5906.00		7902.00		8288.00		8800.00
5		Substation No 4	Lump Sum		7117.00		9609.00		9828.00		10600.00
6		Substation No. 5	Lump Sum		6828.00		8717.00		9428.00		9700.00
7		Battery Station	Lump Sum		1778.00		2426.00		2148.00		2600.00
8		Control Station	Lump Sum		3567.00		4285.00		4666.00		6000.00
9		Distribution Cable	Lump Sum		56,228.00		59944.00		50539.00		61,000.00
10		Control Cable	Lump Sum		62,642.00		60128.00		61,087.00		70,000.00
11		Communication Equipment	Lump Sum		4863.00		6339.00		6760.00		7500.00
12		Communication Equipment Wiring	Lump Sum		899.00		732.00		694.00		1000.00
13		Navigation Lights and Airways Beacon Equipment	Lump Sum		7839.00		9754.00		9880.00		12,300.00
14		Navigation Lights and Airways Beacon Wiring	Lump Sum		19,209.00		16470.00		16,975.00		20500.00
15		Fog Signal Equipment	Lump Sum		1,299.00		1892.00		1846.00		1,300.00
16		Fog Signal Wiring	Lump Sum		16,113.00		11486.00		11,180.00		16,000.00
17		Service Circuit	Lump Sum		18758.00		14393.00		14,525.00		21,000.00
18	78	Lighting Standards, Type B		80.00	6240.00	89.00	6942.00	93.50	7,293.00	67.00	5226.00
19	4	Lighting Standards, Type C		80.00	320.00	96.00	384.00	100.00	400.00	72.00	288.00
20	32	Lighting Standards, Type D		90.00	2880.00	106.00	3392.00	111.00	3,552.00	85.00	2720.00
21	36	Lighting Standards, Type E		100.00	3600.00	115.00	4140.00	122.00	4392.00	100.00	3,600.00
22	110	Lighting Standards, Type F		80.00	8800.00	94.00	10340.00	98.00	10,780.00	73.00	8,030.00
23	48	Lighting Standards, Type G		80.00	3840.00	94.00	4512.00	98.00	4704.00	73.00	3504.00
24	4	Lighting Standards, Type H		30.00	120.00	44.00	176.00	45.00	180.00	45.00	180.00
25	14	Lighting Standards, Type J		80.00	1,120.00	95.00	1330.00	100.00	1400.00	71.00	994.00
26	2	Lighting Standards, Type L		80.00	160.00	92.00	184.00	95.00	190.00	70.00	140.00
27	2	Lighting Standards, Type M		75.00	150.00	85.00	170.00	89.00	178.00	65.00	130.00
28	310	Luminaire Units, Type B		85.00	26,350.00	110.00	34,100.00	113.00	35030.00	113.00	35,030.00
29	14	Luminaire Units Type C		85.00	1,190.00	112.00	1,568.00	120.00	1,680.00	121.00	1,694.00
30	20	Luminaire Units, Type D		85.00	1,700.00	115.00	2300.00	116.00	2,320.00	115.00	2300.00
31	176	Luminaire Units Type E		85.00	14,960.00	112.00	19,712.00	115.00	20,240.00	120.00	21,120.00
32	64	Luminaire Units Type F		85.00	5440.00	113.00	7232.00	113.00	7,232.00	117.00	7488.00
33	6	Luminaire Units Type G		160.00	960.00	200.00	1200.00	212.00	1,272.00	205.00	1,230.00
34	14	Luminaire Units Type J		50.00	700.00	92.00	1,288.00	78.00	1,092.00	85.00	1,190.00
35	4	Luminaire Units Type K		80.00	320.00	109.00	436.00	114.00	456.00	120.00	480.00
36		Roadway Lighting Cable,	Lump Sum		41,482.00		27,961.00		29,056.00		34000.00
37		Spare Equipment	Lump Sum		4882.00		5,648.00		6,001.00		5800.00
		SUB-TOTAL			353324.00		356824.00		365373.00		404444.00
		CONTRACT NO.11A APPROACHES									
38		Substation No. 6	Lump Sum		3107.00		4032.00		4291.00		4400.00
39		Distribution Cable	Lump Sum		7723.00		5667.00		5840.00		6300.00
40		Control Cable	Lump Sum		8857.00		7473.00		8456.00		8800.00
41		Communication Equipment	Lump Sum		253.00		257.00		271.00		300.00
42		Communication Equipment Wiring	Lump Sum		148.00		98.00		84.00		100.00
43		Service Circuits	Lump Sum		1,352.00		1424.00		1485.00		2350.00
44	16	Lighting Standards, Type A		90.00	1440.00	111.00	1776.00	117.00	1,872.00	113.00	1,808.00
45	32	Lighting Standards, Type B		80.00	2560.00	89.00	2048.00	93.00	2,976.00	67.00	2144.00
46	85	Lighting Standards Type C		80.00	6800.00	95.00	8075.00	100.00	8500.00	72.00	6120.00
47	51	Lighting Standards, Type K		75.00	3825.00	87.00	4437.00	91.00	4,641.00	88.00	4488.00
48	16	Luminaire Units, Type A		65.00	1040.00	71.00	1,136.00	94.00	1504.00	78.00	1,248.00
49	176	Luminaire Units, Type B		85.00	14,960.00	109.00	19,184.00	114.00	20,064.00	113.00	19888.00
50	44	Luminaire Units Type G		160.00	7,040.00	200.00	8800.00	214.00	9,416.00	205.00	9,020.00
51	29	Luminaire Units Type H		160.00	4,640.00	203.00	5887.00	217.00	6,293.00	210.00	6090.00
52		Roadway Lighting Cable	Lump Sum		25,569.00		17,749.00		16,942.00		20500.00
53		Spare Equipment	Lump Sum		321.00		378.00		407.00		300.00
		SUB-TOTAL			89615.00		89221.00		93042.00		93856.00
		GRAND-TOTAL			$442939.00		$445845.00		$458415.00		$498300.00

				NEWBERRY ELECTRIC CORP, 315 WEST 9TH ST, LOS ANGELES		BRIDGE BUILDERS INC., OUTER HARBOR, OAKLAND		C.C. MOORE & CO., 450 MISSION ST, SAN FRANCISCO	
		Bidder's Bond / Certified Check		$65000.00		$77000.00		$70000.00	
ITEM	QUANT	DESCRIPTION		UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
		CONTRACT NO 11 BRIDGE							
1		Supply Stations	Lump Sum		7846.00		8500.00		9320.00
2		Substation No 1	Lump Sum		8300.00		12500.00		12,240.00
3		Substation No. 2	Lump Sum		5200.00		8.700.00		8430.00
4		Substation No 3	Lump Sum		9325.00		12,800.00		12,950.00
5		Substation No 4	Lump Sum		8000.00		14.600.00		14750.00
6		Substation No. 5	Lump Sum		11.073.00		13,600.00		14240.00
7		Battery Station	Lump Sum		2958.00		3,100.00		3540.00
8		Control Station	Lump Sum		4827.00		12,300.00		6480.00
9		Distribution Cable	Lump Sum		57,550.00		79,505.00		71,300.00
10		Control Cable	Lump Sum		67,650.00		89,600.00		86,200.00
11		Communication Equipment	Lump Sum		7340.00		12,400.00		11,800.00
12		Communication Equipment Wiring	Lump Sum		807.00		900.00		1868.00
13		Navigation Lights and Airways Beacon Equipment	Lump Sum		11,930.00		12.400.00		17,800.00
14		Navigation Lights and Airways Beacon Wiring	Lump Sum		21,035.00		21,700.00		35.200.00
15		Fog Signal Equipment	Lump Sum		1,390.00		2,900.00		11,360.00
16		Fog Signal Wiring	Lump Sum		14,990.00		15,700.00		26,400.00
17		Service Circuit	Lump Sum		18,634.00		19,300.00		27,100.00
18	78	Lighting Standards, Type B		103.00	8,034.00	121.00	9,438.00	110.40	8611.20
19	4	Lighting Standards, Type C		110.00	440.00	128.00	512.00	115.00	460.00
20	32	Lighting Standards, Type D		121.00	3872.00	142.00	4544.00	132.60	4243.20
21	36	Lighting Standards, Type E		131.00	4,716.00	154.00	5544.00	161.30	5806.80
22	110	Lighting Standards, Type F		106.00	11,660.00	127.00	13970.00	106.10	11,671.00
23	48	Lighting Standards, Type G		108.00	5,184.00	127.00	6096.00	121.10	5,812.80
24	4	Lighting Standards, Type H		52.00	208.00	64.00	256.00	59.70	238.80
25	14	Lighting Standards, Type J		107.00	1498.00	129.00	1806.00	117.50	1,645.00
26	2	Lighting Standards, Type L		102.00	204.00	124.00	248.00	115.40	230.80
27	2	Lighting Standards, Type M		100.00	200.00	117.00	234.00	111.60	223.20
28	310	Luminaire Units, Type B		122.00	37,820.00	144.00	44,640.00	138.00	42,780.00
29	14	Luminaire Units Type C		131.00	1834.00	144.00	2016.00	149.50	2,093.00
30	20	Luminaire Units, Type D		124.00	2480.00	143.00	2860.00	143.50	2,870.00
31	176	Luminaire Units Type E		123.00	21,648.00	143.00	25,168.00	142.00	24992.00
32	64	Luminaire Units Type F		111.00	7,104.00	146.00	9344.00	138.60	8870.40
33	6	Luminaire Units Type G		230.00	1,380.00	273.00	1,638.00	248.50	1,491.00
34	14	Luminaire Units Type J		83.00	1,162.00	104.00	1,456.00	99.30	1,390.20
35	4	Luminaire Units Type K		122.00	488.00	143.00	572.00	136.90	547.60
36		Roadway Lighting Cable,	Lump Sum		31,318.00		44,000.00		35,800.00
37		Spare Equipment	Lump Sum		5364.00		7400.00		7,230.00
		SUB-TOTAL			405469.00		522247.00		537985.00
		CONTRACT NO.11A APPROACHES							
38		Substation No. 6	Lump Sum		4235.00		7500.00		7,080.00
39		Distribution Cable	Lump Sum		11,511.00		10.300.00		6400.00
40		Control Cable	Lump Sum		8.125.00		10.700.00		9.420.00
41		Communication Equipment	Lump Sum		319.00		550.00		469.00
42		Communication Equipment Wiring	Lump Sum		169.00		200.00		162.00
43		Service Circuits	Lump Sum		1,729.00		2,660.00		1.896.00
44	16	Lighting Standards, Type A		124.00	1984.00	147.00	2,352.00	145.50	2,328.00
45	32	Lighting Standards, Type B		101.00	3232.00	121.00	3.872.00	119.00	3808.00
46	85	Lighting Standards Type C		98.00	8330.00	128.00	10.880.00	126.40	10,744.00
47	51	Lighting Standards, Type K		99.00	5049.00	119.00	6.069.00	117.30	5982.30
48	16	Luminaire Units, Type A		80.00	1280.00	100.00	1.600.00	92.80	1,484.80
49	176	Luminaire Units, Type B		128.00	22528.00	144.00	25,344.00	127.30	22404.80
50	44	Luminaire Units Type G		254.00	11.176.00	273.00	12,012.00	248.00	10,912.00
51	29	Luminaire Units Type H		226.00	6554.00	279.00	8091.00	252.00	7308.00
52		Roadway Lighting Cable	Lump Sum		17,491.00		22,900.00		20,100.00
53		Spare Equipment	Lump Sum		405.00		500.00		446.00
		SUB-TOTAL			104117.00		125530.00		110944.90
		GRAND-TOTAL			$509586.00		$647777.00		$648929.90

STATE OF CALIFORNIA

DEPARTMENT OF PUBLIC WORKS

SAN FRANCISCO-OAKLAND BAY BRIDGE

SAN FRANCISCO SECTION AND APPROACHES

Bids Opened December 20, 1934, 2:00 P.M. Room 811, 500 Sansome St., S.F.

CONTRACT NO. 15 AND NO. 15 A

TABULATION OF BIDS

ITEM	QUANTITIES	UNIT	DESCRIPTION	HEALY-TIBBITTS CONST. CO., 64 PINE ST., SAN FRANCISCO; Bidders Bond —; Certified Check $135,000.00		CLINTON CONST. CO. OF CAL., 923 FOLSOM ST., SAN FRANCISCO; $200,000.00		TRANSBAY CONST. COMPANY, PIER 24, SAN FRANCISCO; $200,000.00		C.W. CALETTI & CO., M.B. McGOWAN INC., PENINSULA PAV. CO., 9 MAIN ST., SAN FRANCISCO; $160,000.00		BATES & ROGERS CONST. CO., P.O. BOX 883, OAKLAND; $175,000.00		BARRETT & HILP, 918 HARRISON ST., SAN FRANCISCO; $166,000.00	
				UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
			SAN FRANCISCO CONTRACT NO. 15 SECTION												
1			Remove Buildings and Clear Site.		7,500.00		17,000.00		23,000.00		100,000.00		35,170.00		32,000.00
2	16,000	Cu. Yards	Excavation - Unclassified.	.50	8,000.00	.60	9,600.00	.55	8,800.00	.69	11,040.00	.65	10,400.00	.72	11,520.00
3	10,000	Cu. Yards	Excavation - Structure.	2.50	25,000.00	2.40	24,000.00	1.75	17,500.00	1.25	12,500.00	2.95	29,500.00	1.50	15,000.00
4	3,700	Cu. Yards	Concrete - Viaduct and Wall Footings.	11.00	40,700.00	8.50	31,450.00	9.00	33,300.00	15.00	55,500.00	8.75	32,375.00	8.50	31,450.00
5	21,200	Cu. Yards	Concrete - Viaduct and Walls above Footings	16.50	349,800.00	15.80	334,960.00	20.00	424,000.00	19.00	402,800.00	20.95	444,140.00	20.50	434,600.00
6	800	Cu. Yards	Concrete - Railing	30.00	24,000.00	21.00	16,800.00	30.00	24,000.00	40.00	32,000.00	39.65	31,720.00	50.00	40,000.00
7	4,100,000	Pounds	Reinforcing Steel	.04	164,000.00	.042	172,200.00	.04	164,000.00	.04	164,000.00	.038	155,800.00	.042	172,200.00
8	6,600	Pounds	Bronze Castings	.28	1,848.00	.37	2,442.00	.40	2,640.00	.30	1,980.00	.50	3,300.00	.34	2,244.00
9	45,000	Pounds	Cast Iron Drain Pipe and Fittings	.05	2,250.00	.06	2,700.00	.06	2,700.00	.05	2,250.00	.07	3,150.00	.12	5,400.00
10	20,000	Pounds	Casting	.07	1,400.00	.07	1,400.00	.11	2,200.00	.05	1,000.00	.10	2,000.00	.13	2,600.00
11	6,000	Lineal Ft.	16" Concrete Piles	3.50	21,000.00	1.75	10,500.00	1.75	10,500.00	1.25	7,500.00	2.45	14,700.00	2.50	15,000.00
12	8,500	Lineal Ft.	18" Concrete Piles	4.25	36,125.00	2.40	20,400.00	2.40	20,400.00	1.50	12,750.00	2.95	25,075.00	3.05	25,925.00
13	800	Lineal Ft.	6" Vitrified Clay Pipe	1.50	1,200.00	1.00	800.00	2.30	1,840.00	2.00	1,600.00	2.40	1,920.00	2.00	1,600.00
14	1,000	Lineal Ft.	8" Vitrified Clay Pipe	1.75	1,750.00	4.00	4,000.00	4.60	4,600.00	2.00	2,000.00	4.75	4,750.00	2.50	2,500.00
15	150	Lineal Ft.	10" Vitrified Clay Pipe	2.00	300.00	4.50	675.00	3.50	525.00	2.00	300.00	5.35	802.50	3.50	525.00
16			Electrical Conduits and Fittings		5,302.00		8,400.00		7,456.00		12,500.00		6,450.00		7,000.00
17	4,000	Barrells	Extra Portland Cement	1.25	5,000.00	2.00	8,000.00	2.30	9,200.00	2.00	8,000.00	2.10	8,400.00	2.40	9,600.00
			SUB-TOTAL		695,175.00		665,327.00		756,661.00		827,720.00		809,652.50		809,164.00
			SAN FRANCISCO CONTRACT NO. 15 A APPROACHES												
20			Remove Buildings and clear site		2,500.00		17,000.00		14,000.00		50,000.00		15,700.00		28,000.00
21	300,000	Cu. Yards	Excavation - Unclassified	.40	120,000.00	.575	172,500.00	.55	165,000.00	.69	207,000.00	.65	195,000.00	.72	216,000.00
22	4,000	Cu. Yards	Excavation - Structure	2.50	10,000.00	2.70	10,800.00	1.75	7,000.00	1.25	5,000.00	3.80	15,200.00	1.50	6,000.00
23	1,200	Cu. Yards	Concrete - Viaduct and Wall Footings	11.00	13,200.00	10.00	12,000.00	10.00	12,000.00	15.00	18,000.00	8.75	10,500.00	11.00	13,200.00
24	8,000	Cu. Yards	Concrete - Viaduct and Wall above Footings	17.50	140,000.00	17.30	138,400.00	20.00	160,000.00	12.50	100,000.00	23.00	184,000.00	22.50	180,000.00
25	800	Cu. Yards	Concrete - Railings	30.00	24,000.00	22.00	12,600.00	25.00	20,000.00	40.00	32,000.00	42.85	34,280.00	50.00	40,000.00
26	3,000	Cu. Yards	Concrete - Pavement	7.00	21,000.00	10.00	30,000.00	9.25	27,750.00	10.00	30,000.00	11.00	33,000.00	11.50	34,500.00
27	400	Cu. Yards	Concrete - Curbs and Gutters	10.00	4,000.00	19.00	7,600.00	12.50	5,000.00	12.50	5,000.00	16.65	6,660.00	17.00	6,800.00
28	400	Cu. Yards	Concrete - Sidewalks	10.00	4,000.00	15.00	6,000.00	13.00	5,200.00	12.50	5,000.00	16.65	6,660.00	14.50	5,800.00
29	2,000,000	Pounds	Reinforcing Steel	.04	80,000.00	.042	84,000.00	.04	80,000.00	.04	80,000.00	.0375	75,000.00	.042	84,000.00
30	5,000	Pounds	Bronze Castings	.21	1,050.00	.33	1,650.00	.40	2,000.00	.30	1,500.00	.50	2,500.00	.34	1,700.00
31	15,000	Pounds	Cast Iron Drain Pipe and Fittings	.05	750.00	.07	7,050.00	.06	900.00	.05	750.00	.07	2,050.00	.12	1,800.00
32	14,000	Pounds	Castings	.07	980.00	.06	840.00	.11	1,540.00	.05	700.00	.10	1,400.00	.13	1,820.00
33	4,000	Lineal Ft.	16" Concrete Piles	2.50	10,000.00	2.15	8,600.00	.75	7,000.00	1.25	5,000.00	2.45	9,800.00	2.50	10,000.00
34	4,000	Lineal Ft.	18" Concrete Piles	4.25	17,000.00	2.75	11,000.00	2.40	9,600.00	1.50	6,000.00	2.95	11,800.00	3.05	12,200.00
35	100	Lineal Ft.	6" Vitrified Clay Pipe	7.50	750.00	1.00	100.00	2.30	230.00	2.00	200.00	2.40	240.00	2.00	200.00
36	1,000	Lineal Ft.	8" Vitrified Clay Pipe	1.7	1,750.00	4.00	4,000.00	4.60	4,600.00	2.00	2,000.00	4.75	4,750.00	2.50	2,500.00
37	1,200	Lineal Ft.	10" Vitrified Clay Pipe	2.00	2,400.00	2.00	2,400.00	3.45	4,140.00	2.00	2,400.00	4.75	5,700.00	3.50	4,200.00
38	2,800	Tons	Crusher Run Base	1.00	2,800.00	1.85	5,180.00	2.00	5,600.00	2.00	5,600.00	1.85	5,180.00	2.10	5,880.00
39	2,200	Tons	Asphalt Concrete	3.50	7,700.00	4.60	10,120.00	5.50	12,100.00	3.50	7,700.00	4.50	9,900.00	5.50	12,100.00
40			Electrical Conduits and Fittings		4,802.00		5,000.00		6,850.00		12,000.00		4,810.00		7,000.00
41			Remove and Replace 12"×18" Brick Sewer on Essex Street between Harrison and Folsom Streets		1,890.00		1,700.00		2,300.00		3,356.00		3,150.00		7,400.00
42			Remove and Rebuild 12" and 10" V.C. Sewers on Harrison between First and Second Streets		3,375.00		2,800.00		2,300.00		5,000.00		5,500.00		6,000.00
43			Remove and Replace 12" Cast Iron Water Main on Harrison St. between 2nd and Essex Streets.		1,000.00		1,200.00		2,300.00		2,000.00		3,575.00		1,500.00
44	2,200	Barrels	Extra Portland Cement	1.25	2,750.00	2.00	4,400.00	2.30	5,060.00	2.00	4,400.00	2.10	4,620.00	2.40	5,280.00
			SUB-TOTAL		477,447.00		555,940.00		562,470.00		590,606.00		649,975.00		688,880.00
			GRAND-TOTAL		$1,172,622.00		$1,221,267.00		$1,319,131.00		$1,418,326.00		$1,459,627.50		$1,498,044.00

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
PROGRESS CHART
WEST BAY PAVING
EAST BAY PAVING

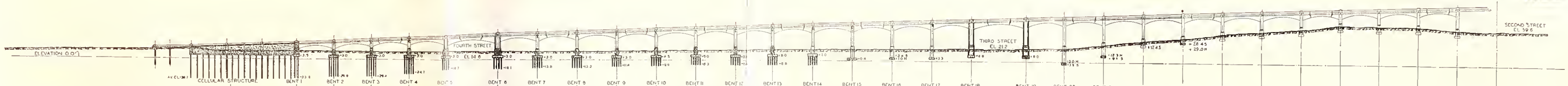
CORRECTED TO JUNE 30, 1935

D—West Bay Paving and East Bay Pavir

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
PROGRESS CHART
EAST BAY CROSSING
CORRECTED TO JUNE 30, 1935

PROGRESS OF STEELWORK			
UNIT		TOTAL TO DATE POUNDS	%
ANCHORAGE STEELWORK TOTAL WT. 5,000,000 LBS.	MILL	5,000,000	100%
	SHOP	5,000,000	100%
	ON HAND	5,000,000	100%
	ERECTED	4,400,000	88%
TOWERS TOTAL WT. 48,600,000 LBS.	MILL	48,600,000	100%
	SHOP	48,100,000	99
	ON HAND	47,700,000	98
	ERECTED	46,600,000	97
WIRE TOTAL WT. 37,500,000 LBS.	MILL	31,500,000	84
	SHOP	26,500,000	71
	ON HAND	26,500,000	71
	ERECTED	400,000	1
CABLE CASTINGS TOTAL WT. 2,000,000 LBS.	MILL	2,000,000	100
	SHOP	2,000,000	100
	ON HAND	2,000,000	100
	ERECTED	20,000	1
SUSPENDER ROPE TOTAL WT. 1,900,000 LBS.	MILL	1,900,000	100
	SHOP	1,800,000	95
	ON HAND	1,400,000	73
	ERECTED	0	0
SUSPENDED STRUCTURE TOTAL WT. 80,000,000 LBS.	MILL	79,100,000	99
	SHOP	45,900,000	57
	ON HAND	40,900,000	51
	ERECTED	500,000	1
TOTAL STEELWORK TOTAL WT. 175,000,000 LBS.	MILL	168,100,000	96
	SHOP	129,300,000	74
	ON HAND	123,500,000	71
	ERECTED	52,120,000	30

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
PROGRESS CHART
WEST BAY CROSSING
CORRECTED TO JUNE 30, 1935

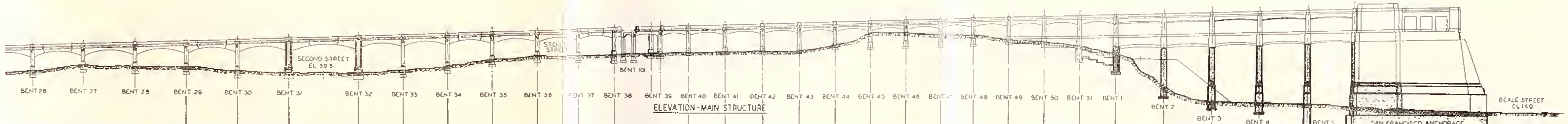


ELEVATION - MAIN STRUCTURE

		Cellular Structure	Bent 1	Bent 2	Bent 3	Bent 4	Bent 5	Bent 6	Bent 7	Bent 8	Bent 9	Bent 10	Bent 11	Bent 12	Bent 13	Bent 14
FOUNDATIONS	EXCAVATION	4-25-35	4-24-35	5-10-35	5-7-35	5-10-35	5-13-35	5-6-35	5-10-35	5-15-35	5-15-35	5-17-35	5-20-35	5-23-35	5-24-35	
	PILES	4-8-35	4-12-35	5-7-35	5-1-35 S	4-30-35	4-23-35	5-2-35	5-6-35	5-7-35	5-9-35	5-13-35	5-14-35	5-17-35	5-22-35	6-27-35
	FOOTINGS	4-25-35	4-24-35	5-10-35	5-7-35	5-2-35	[illegible]	5-6-35	5-10-35	5-15-35	5-16-35	5-20-35	5-20-35	5-24-35	5-24-35	
	COLUMN BASE	4-12-35 / 5-17-35	5-8-35	5-17-35	5-16-35	5-10-35	5-10-35	6-5-35	5-28-35	5-28-35	6-5-35	6-5-35	6-5-35	6-11-35	6-11-35	
	COLUMN TO GIRDERS	4-12-35 / 5-17-35	5-17-35													

		Bent 15	Bent 16	Bent 17	Bent 18	Bent 19	Bent 20	Bent 21	Bent 22	Bent 23	Bent 24	Bent 25	Bent 26	Bent 27	Bent 28	Bent 29	Bent 30
FOUNDATIONS	EXCAVATION	5-17-35	5-23-35	5-28-35	5-7-35	6-3-35	6-10-35	6-17-35	7-6-35	6-20-35	6-25-35	7-17-35	7-20-35	7-25-35	7-27-35	8-1-35	
	PILES																
	FOOTINGS	5-17-35	5-24-35	5-28-35	5-28-35	6-4-35	6-11-35	6-17-35	7-6-35	6-24-35	7-14-35	7-17-35	7-20-35	7-25-35	7-27-35	8-1-35	
	COLUMN BASE							7-1-35	7-11-35	7-18-35	7-19-35	7-22-35	7-25-35	8-1-35	8-3-35	8-6-35	
	COLUMN TO GIRDERS							7-16-35	7-21-35	7-25-35	8-1-35	8-4-35	8-5-35	8-10-35	8-12-35	8-15-35	

SUPERSTRUCTURE	
GIRDERS	4-29-35, 5-23-35, 7-15-35, 6-20-35, 7-26-35, 7-15-34, 8-15-35, 8-15-35, 8-25-35, 8-15-35, 9-5-35, 8-21-35, 9-26-34
SLAB	5-14-35, 6-3-35, 7-20-35, 6-25-35, 8-1-35, 7-20-34, 9-20-35, 8-10-35, 9-1-35, 8-20-35, 9-10-35, 9-1-35, 10-1-35
RAILING	8-20-35, 9-1-35, 9-20-35, 10-1-35, 10-10-35, 11-1-35

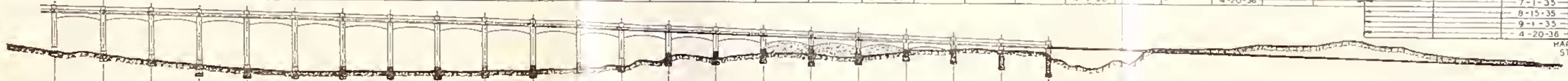


ELEVATION - MAIN STRUCTURE

		Bent 29	Bent 30	Bent 31	Bent 32	Bent 33	Bent 34	Bent 35	Bent 36	Bent 37	Bent 38	Bent 39–40	Bent 41
FOUNDATIONS	EXCAVATION	8-1-35	8-15-35	8-30-35	9-15-35	10-1-35	10-21-35	10-28-35	11-6-35	-15-35	11-25-35	12-5-35	12-15-35
	PILES												
	FOOTINGS	8-1-35	8-15-35	8-30-35	9-15-35	10-1-35	10-21-35	10-28-35	11-6-35	-8-35	11-25-35	12-5-35	12-15-35
	COLUMN BASE	8-6-35	8-20-35	9-10-35	9-20-35	10-6-35	10-26-35	11-3-35	11-10-35	-20-35	12-1-35	12-10-35	12-20-35
	COLUMN TO GIRDERS	8-15-35	8-30-35	9-15-35	9-25-35	10-16-35	11-5-35	11-12-35	11-20-35	-30-35	12-10-35	12-20-35	1-1-36

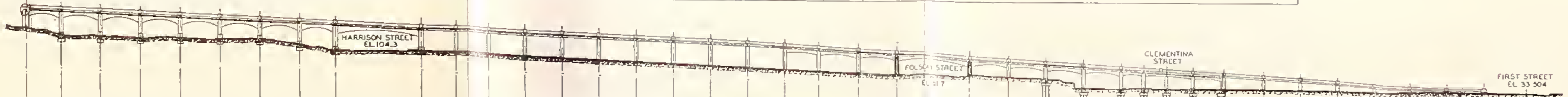
		Bent 42	Bent 43	Bent 44	Bent 45	Bent 46	Bent 47	Bent 48	Bent 49	Bent 50	Bent 51	Bent 1	Bent 2	Bent 3	Bent 4	Bent 5	Bent 6
FOUNDATIONS	EXCAVATION	12-20-35	12-25-35	1-1-36	1-7-36	1-14-36	1-21-36	1-28-36	2-5-36	2-12-36	2-20-36	11-1-34	9-19-34	7-24-34	6-29-34	6-13-34	
	PILES																
	FOOTINGS	12-20-35	12-25-35	1-1-36	1-7-36	1-14-36	1-21-3[illegible]	1-28-36	2-5-36	2-12-36	2-20-36	11-15-34	9-20-34	7-25-34	6-29-34	6-13-34	
	COLUMN BASE	12-25-35	1-1-36	1-5-36	1-12-36	1-19-36	1-26-[illegible]	2-3-36	2-10-36	2-17-36	2-25-36						
	COLUMN TO GIRDERS	1-5-36	1-10-36	1-15-36	1-20-36	1-29-36	2-[illegible]	2-13-36	2-20-36	2-27-36	3-5-36	5-31-35	5-22-35	4-18-35	4-18-35	4-18-35	5-22-35

SUPERSTRUCTURE	
GIRDERS	-35, 9-25-35, 12-10-35, 11-16-35, 1-10-36, 12-10-35, 2-1-, 1-10-36, 2-1-36, 3-1-36, 3-15-36, 7-1-35
SLAB	-35, 9-30-35, 12-15-35, 11-21-35, 1-15-36, 12-15-35, 2-7, 1-15-36, 2-7-36, 3-7-36, 3-20-36, 7-1-35
RAILING	11-1-35, 1-15-36, 2-15-36, 3-7-36, 3-7-36, 4-7-36, 4-20-36, 7-1-35
	8-15-35
	9-1-35
	4-20-36



ELEVATION - UPPER DECK "ON" RAMP

		Bent 38	Bent 101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	Bent 121
FOUNDATIONS	EXCAVATION				6-21-35	6-24-35	6-21-35	6-18-35	6-18-35	6-14-35	6-14-35	6-14-35			6-7-35								
	PILES																	2-22-35	2-22-35	2-22-35	2-22-35	2-22-35	2-22-35
	FOOTINGS				6-24-35	6-24-35	6-24-35	6-21-35	6-18-35	6-14-35	6-14-35	6-18-35	6-18-[illegible]	6-27-35	6-27-35	6-12-35	6-12-35	2-22-35	2-22-35	2-22-35	2-22-35	2-22-35	2-22-35
	COLUMN BASE							6-21-35	6-21-35	6-21-35	6-21-35	6-21-35	6-2[illegible]		6-27-35	6-27-35	6-27-35	3-14-35	3-14-35	3-14-35	3-14-35	3-14-35	3-14-35
	COLUMN TO GIRDERS																						
SUPERSTRUCTURE	GIRDERS																6-27-35		5-23-35				
	SLAB																						
	RAILING																						



ELEVATION - UPPER DECK "OFF" RAMP

FOUNDATIONS	EXCAVATION	
	PILES	
	FOOTINGS	
	COLUMN BASE	
	COLUMN TO GIRDERS	
SUPERSTRUCTURE	GIRDERS	
	SLAB	
	RAILING	

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

SAN FRANCISCO-OAKLAND BAY BRIDGE
PROGRESS CHART
SAN FRANCISCO APPROACHES
CORRECTED TO JUNE 30 1935


SUSPENSION
TO SAN FRANCISCO
ANCHORAGE
VIADUCT
Y.B.1
Y.B.2
Y.B.3
Y.B.4
E.1
BRIDGE APPROACH
CANTILEVER
TO OAKLAND
GROUND LINE AT C OF BRIDGE
ANCHORAGE TUNNEL
TYPICAL TUNNEL SECTION
EXCAVATION LEGEND
VIADUCT-ANCHORAGE TO WEST PORTAL
PROGRESS-VIADUCT-EAST PORTAL TO PIER Y.B.1.
COMPLETION DATES
COMPLETE EXCEPT RAIL
SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
SECTION E-E
SECTION F-F
PROGRESS OF YERBA BUENA TUNNEL
540 FT TUNNEL
EXCAVATION
CONCRETE
VIADUCT TYPICAL SECTION
BENT #5 - 155+75 WEST OF TUNNEL
BENT #45 - 166+53 EAST OF TUNNEL
ANCHORAGE
YERBA BUENA ANCHORAGE
ANCHORAGE TUNNELS
PIER Y.B.1.
PIER Y.B.2.
PIER Y.B.3.
PIER Y.B.4.
PIER E.1.
SECTIONS
PLAN OF ANCHORAGE TUNNELS
TYPICAL TUNNEL SECTION
CONCRETE LEGEND
SECTION-ANCHORAGE TO WEST PORTAL
SECTION-EAST PORTAL TO BENT NO. 48A.
NORTH CABLE BENT
CABLE BENT AND ANCHOR CHAINS SOUTH TUNNEL (NORTH TUNNEL IDENTICAL)
PLAN
NORTH TUNNEL
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
PROGRESS CHART
YERBA BUENA ISLAND
CORRECTED TO JUNE 30, 1935